JOURNAL

OF THE NEW ENGLAND WATER ENVIRONMENT ASSOCIATION

VOLUME 54 NUMBER 4 / ISSN 1077-3002 **WINTER 2020**

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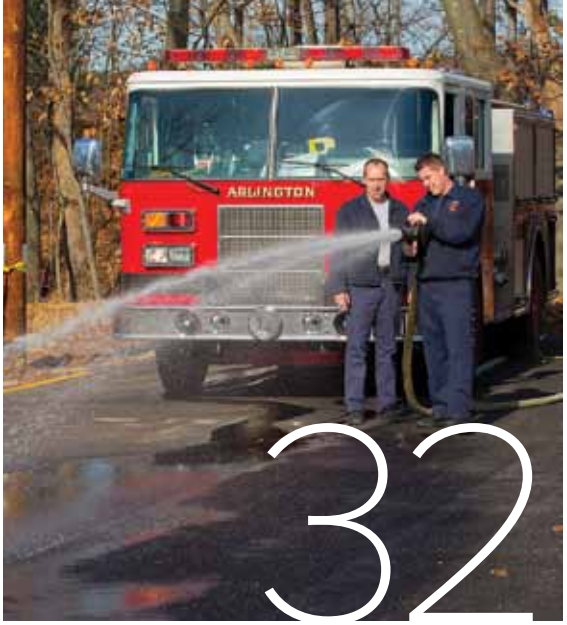

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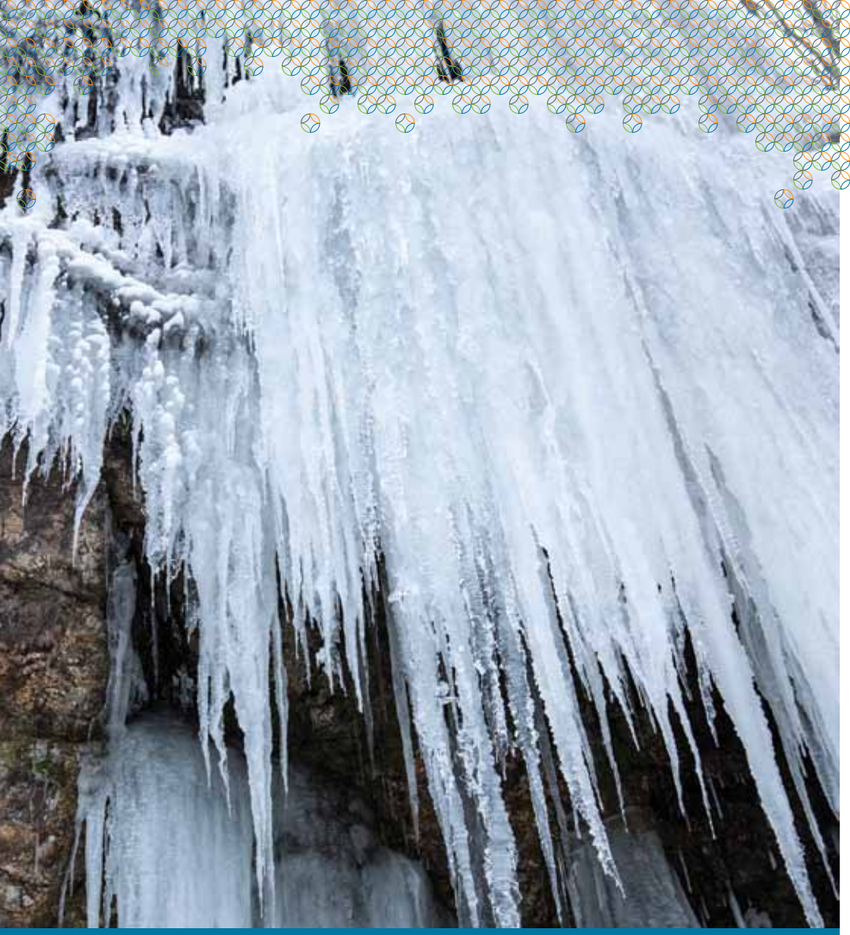

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Seymour Lake (page 10)
Seymour Lake Association

OUR ASSOCIATION WAS ORGANIZED NINETY-ONE YEARS AGO in Hartford, Connecticut, on April 23, 1929, with the objectives of advancing the knowledge of design, construction, operation and management of waste treatment works and other water pollution control activities, and encouraging a friendly exchange of information and experience. From 40 charter members, the membership has steadily grown to more than 2,000 today. Membership is divided into the following classes:

Professional Member—shall be any individual involved or interested in water quality including any manager or other officer of a private waste treatment works; any person engaged in the design, construction, financing, operation or supervision of pollution control facilities, or in the sale or manufacture of waste treatment equipment.

Executive Member—shall be an upper level manager interested in water quality and who is interested in receiving an expanded suite of WEF products and services.

Corporate Member—shall be a sewerage board, department or commission; sanitary district; or other body, corporation or organization engaged in the design, consultation, operation or management of water quality systems.

Regulatory Member—this membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, Connecticut Department of Energy and Environmental Protection, Maine Department of Environmental Protection, Massachusetts Department of Environmental Protection, New Hampshire Department of Environmental Services, Vermont Department of Environmental Conservation, and Rhode Island Department of Environmental Management.

Academic Member—shall be an instructor or professor interested in subjects related to water quality.

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Professional Wastewater Operations Member (PWO)—shall be any individual who is actively involved on a day-to-day basis with the operation of a wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of <1 million gallons per day. Membership is limited to those actually employed in treatment and collection facilities.

Student Member—shall be a student enrolled for a minimum of six credit hours in an accredited college or university.

WEF Utility Partnership Program (UPP)—NEWEA participates in the WEF Utility Partnership Program (UPP) that supports utilities to join WEF and NEWEA while creating a comprehensive membership package for designated employees. As a UPP a utility can consolidate all members within its organization onto one account and have the flexibility to tailor the appropriate value packages based on the designated employees' needs. Contact WEF for questions & enrollment (703-684-2400 x7213).

BECOME A NEWEA MEMBER

- Complete and mail the membership application form on pages 71–72
- Download a membership application from **newea.org** by selecting—*Join Us/Become a NEWEA Member*
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2020 RATES ($)

Professional	185
Executive	355
Corporate	420
Regulatory	50
Academic	185
Young Professional	70
PWO	110
Dual	45
Student	15

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Legitimate paid and/or requested distribution	Outside country paid/requested mail subscriptions	0	0
	In-country paid/ requested mail subscriptions	2,200	2,200
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Total distribution		2,208	2,008
Copies not distributed		292	492
Total		2,500	2,500
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President's Message

Here we are nine months into life during a pandemic. And this will be my last President's Message as we welcome our new officers in January. We continue this year with many "firsts" or new ways of doing things, and WEFTEC—WEF Connect—was another event modified to many virtual experiences.

Congratulations to all the NEWEA members who participated in WEF events from technical presentations (35 NEWEA members presented papers) to committee meetings to award recipients, such as Charlie Tyler (WEF Fellow), to Operations Challenge. As Paul Dombrowski summarized:

> Although we had only one Ops Challenge team compete this year, our team from Maine, Force Maine, did us proud (again!). This year's competition comprised three events—Process, Lab, and Collections, all done virtually. Usually, our NEWEA teams crush the Process event. However, Force Maine placed in all three of the events (two 2nds and a 3rd) that took place this year and finished 3rd overall in Division 2. Please congratulate Alex Buechner and Scott Lausier, who were this year's team. Also, hats off to Mike Harris from Ellsworth, Maine, who judged the Operations Challenge this year. They did a fantastic job!

As many of you probably know, Ifetayo Venner (my southern colleague) is now the vice president of WEF and will become the WEF president in 2022. Our own Diversity, Equity, and Inclusion Committee has already secured having Ms. Venner speak on a panel for our upcoming Annual Conference in January 2021. How awesome is that? What you may not know is that she began her career in New England and her first member association was NEWEA back in 2000. I asked Ms. Venner about that recently, and here is what she said:

> I recall when I first went to the NEWEA conference my first year I thought, 'Wow, I don't see many people who look like me or people I grew up with here,' and I almost walked out; and I remember wondering if there was a place for me to move forward in the sector or NEWEA. I am so glad I stayed—everyone could not have been more welcoming, and they showed a passion for the water sector that showed me I was in the right place. I got engaged with the Students and Young Professionals (YP) Committee activities and the student competition (I think it was just posters) with Francis Hopcroft. Shortly before I moved to Florida, I attended some board meetings as a YP representative.

1st row top (left to right): John Trofatter, Lynn Broaddus, Rajendra Bhattarai; 2nd row: Aimee Killeen, Jacqueline Jarrell, WEF Executive Director—Walter Marlowe; 3rd row: Keith Hobson, Ifetayo Venner, Howard Carter; 4th row: Jamie Eichenberger, Shellie Chard, Gustavo Gallo

Stay tuned, as you will get to interact with Ms. Venner at our Annual Conference. She is pictured above in the middle of the second row from the bottom and of course on her left is our own Howard Carter.

Since we have not had much opportunity (as in NEWEA presidential terms in more normal years) to meet in person at NEWEA events, I wanted to share a recent photo of my family with you all. This picture was taken in November at my daughter's graduation—with her PhD in chemistry! We are so proud. On my right is Alex, my husband of 34 years, and on the far right our son, Ryan, who is a mechanical engineer living in Rhode Island. I am blessed to have such a wonderful family. Between Ryan and me is Dr. Kätchen Kelly Lachmayr. In addition, I also have five brothers, and the funny part is that of the six siblings, I am the only engineer!

As mentioned in previous issues of the *Journal*, with the continuing pandemic NEWEA is moving all specialty conferences and the Annual Conference to a virtual format. The good news is we have had nine months to work some kinks out of the virtual meeting format and to reap the benefits of lessons learned from WEF and so many other events that have gone virtual, so we look forward to a productive, if not socially satisfying, Annual Conference.

Our own Diversity, Equity, and Inclusion Committee has already secured having the WEF vice president, Ifetayo Venner, speak on a panel for our upcoming Annual Conference in January 2021

From the Editor

Stormwater issues have long lacked the attention given to other environmental issues considered to be more "pressing." One need look no further than the history of the Clean Water Act, amended by Congress in 1972 to prohibit the discharge of pollutants to waters of the United States from point sources, unless authorized by a National Pollutant Discharge Elimination System (NPDES) permit. That initial focus was on reducing pollutants from point sources—most obviously "sewage plants"; it's easy to point a finger to an effluent flowmeter and record the data necessary to determine the pounds per day of nitrogen discharged to the Long Island Sound, for example. But as NPDES permits were implemented, it became evident that other, non-point sources of water pollution still contributed to water quality impairment. Stormwater, enter stage right: Finally, in 1987, Municipal Separate Storm Sewer System (MS4) programs were introduced and incorporated into the Clean Water Act, with the Phase II Final Rule published in December 1999.

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Likewise, stormwater is often lost among other aspects of concern in people's lives. As an example, my lovely husband grew up in the Valley of the Sun—scenic, arid Scottsdale, Arizona. When he first moved to Boston, his incessant rhetoric sounded the usual complaints of newcomers: obnoxious Patriots' fans, foul Dunkin Donuts coffee, and, of course, the busted, buckled, worn out roads. Aside from his take on misunderstood Patriots fans and his unfair ruling on the quality of Dunkin's coffee, I'd consider his visceral reactions to New England's roadways to be commonly held. It's on these roads where we're forced to silence Waze alerting us to "pothole reported ahead" every two minutes. But he, like many others outside our industry, has not complained much about lack of stormwater management provisions, except for events like last year's storm surge that flooded Boston's Atlantic Avenue in January, making for a cold and sloshy tread home from work.

The American Society of Civil Engineers (ASCE) Infrastructure Report Card is perhaps the most mainstream publication that references our industry: It helps lobbyists who plead for funding when they're at Capitol Hill be able to say, "Our nation's roads have a grade point average of D, and here's the report to prove it." Despite intensified weather patterns, increased rainfall, and more frequent storms, the ASCE report card has not recognized stormwater as a critical infrastructure category. The water industry is considered to be data poor compared to other industries such as transportation, and within the water industry, stormwater is the poorest.

The Water Environment Federation sought to rectify this data gap by creating the MS4 Needs Assessment Survey, first administered in 2018—the first nationwide survey of common stormwater-sector needs. The survey was administered again in 2020. These surveys aim to identify information and technology resource needs of MS4 permittees and to gain insight into the challenges program managers face. The 2020 survey showed a more than 20 percent increase in respondents since the 2018 survey, proving that it's gaining traction. This survey creates a database of MS4 permittees that can be tracked over time. With this newly collected data, a major victory of 2020 is that ASCE has recently accepted stormwater as its newest infrastructure sector for the upcoming ASCE Report Card in 2021!

The Council of Infrastructure Financing Authorities estimates the national State Revolving Fund (SRF) pipeline filled with water, wastewater, and stormwater infrastructure needs totals $73 billion (yes, B, as in Bezos). Of this $73 billion, $2.92 billion is needed in New England. Of that $2.92 billion, $2.03 billion is specifically for Clean Water SRF projects. The National Municipal Stormwater Alliance (NMSA) completed an evaluation and discovered that nationally less than 5 percent of the Clean Water SRF assistance has gone to stormwater projects. That's a sadly small investment in projects that provide numerous immediate benefits to communities aside from improving water quality. These benefits include promoting public health, enhancing resiliency, and fostering the green job workforce, all of which are particularly important within environmental justice communities. There's major work to be done!

This edition of the *Journal* is filled with highlights of our region's stormwater management successes. The NEWEA Stormwater Committee, led by Angela Blanchette, continues to advocate for stormwater management implementation and funding. With the presidential election behind us, we can hope that our representatives move forward with passing an economic stimulus bill that supports the water industry. Getting stormwater into the ASCE report card should certainly help these important projects get the larger piece of the pie they rightfully deserve.

Industry News

The Seymour Lake Association, Morgan, Vermont, won the 2020 EPA Environmental, Community, Academia, and Non-Profit Merit Award for addressing high phosphorus levels

EPA Awards Funding to Address Water Infrastructure in Massachusetts, Vermont, and Rhode Island

EPA has announced funding of $90 million for major water infrastructure projects in communities across Massachusetts, $19 million to protect clean water and drinking water in Vermont, and loans and grants of $196.4 million for infrastructure projects in Rhode Island.

Massachusetts

In two annual amounts, EPA is awarding Massachusetts nearly $54 million for the Clean Water State Revolving Fund (CWSRF) and $25 million for the Drinking Water State Revolving Fund (DWSRF). This funding is available for a wide range of water infrastructure projects, including modernizing aging wastewater infrastructure, addressing stormwater, and improving drinking water infrastructure.

WIFTA Funding Transfer

EPA is also announcing funding to address lead in drinking water in schools and child care facilities in communities across Massachusetts by facilitating a one-time transfer of $30 million from the state's CWSRF to its DWSRF for lead-related, DWSRF-eligible projects. This funding was facilitated by the Water Infrastructure Fund Transfer Act (WIFTA) passed in 2019 that allowed states a one-time transfer from the CWSRF to the DWSRF for lead-related, DWSRF-eligible projects. The funds transferred are to be used by the state to provide a 100 percent additional subsidy. Massachusetts transferred $30 million on September 30, 2020, for lead abatement projects.

In addition to these sums, EPA announced grant funding to address lead in drinking water in schools in Boston, and schools and child care facilities in communities across Massachusetts. The Commonwealth of Massachusetts Clean Water Trust will receive $3 million, and Boston Public Schools will receive $6.2 million. EPA has also awarded the Massachusetts Department of Environmental Protection $1.28 million over three fiscal years—2018 through 2020—to improve testing for lead in drinking water in schools and child care facilities under the Water Infrastructure Improvements for the Nation Act (WIIN). These were among the first-ever selections under WIIN Reduction in Lead Exposure via Drinking Water grants, which will assist schools and child care facilities in disadvantaged communities by installing thousands of water fountains and bottle filling stations in hundreds of schools and child care facilities throughout Massachusetts. More robust testing for lead in drinking water will reduce childhood exposure to lead through routine water testing, notification, and practices to remove lead from drinking water.

Vermont

EPA is awarding nearly $18.8 million to support water infrastructure improvements in Vermont.

Vermont Department of Environmental Conservation also received EPA funding, $295,000 over three fiscal years—2018 through 2020—to improve testing for lead in drinking water in schools and child care facilities under WIIN. This funding supports a state management strategy for testing lead in water that will prioritize sampling in schools and child care facilities in underserved communities.

Rhode Island

EPA announced a $190 million loan to the Narragansett Bay Commission (NBC) under the Water Infrastructure Finance and Innovation Act (WIFIA) for resiliency improvements to its Bucklin Point treatment facility that will help reduce pollutant discharges into Narragansett Bay. The new loan will augment a $269 million loan announced in 2019 to help fund the Combined Sewer Overflow (CSO) Phase IIIA Facilities project. This project is the second WIFIA loan awarded in New England to help protect public health and the ecosystems of the largest estuary in this region.

EPA also awarded a $6.4 million grant to Providence Water for lead service line replacement projects under WIIN. The grant will fund, at no cost to homeowners, the removal and replacement of an estimated 1,400 private lead lines from households within the distribution system. For such replacements, Providence Water will replace, at its cost, any public lead pipes that may be connected to the private lead lines. Along with recent upgrades made by Providence Water to its corrosion control treatment system, this EPA grant will help get the lead out of drinking water at the taps of citizens throughout Providence and surrounding communities.

Note: All EPA industry news provided by EPA Press Office

"Especially during Children's Health Month, EPA is proud to further support our state and local partners' critical work to reduce children's exposure to lead levels in drinking water by replacing water fountains and installing filtered bottle filling stations which work to get the lead out," said EPA New England Regional Administrator Dennis Deziel. "These projects will result in tangible and lasting benefits by advancing health protections for children, our most vulnerable population, with a focus on cities and disadvantaged communities across New England."

New England Organizations and Individuals Recognized by EPA

In September, EPA recognized organizations and individuals from across New England for their work to protect New England's environment.

The Environmental Merit Awards, given since 1970, honor individuals and groups who have shown ingenuity and commitment. The awards recognize work or actions in the prior year and are given in the categories of individual; business (including professional organizations); local, state, or federal government; and environmental, community, academia, or non-profit organization. Each year EPA also presents lifetime achievement awards. This year, the 24 recipients were honored by EPA's New England office at the 2020 Environmental Merit Awards virtual ceremony.

"Initiatives led by individuals and groups like this year's awardees have driven progress toward clean water and clean air, built community support for revitalization investments, sparked environmental innovation, reduced waste, and protected the public from exposure to harmful substances," said EPA's Mr. Deziel. "EPA is always proud to recognize the honorees' dedication, commitment to partnerships, and passion for success that has led to measurable change."

VERMONT AWARD WINNERS

Lifetime Award to Colleen Hickey of Burlington for her 27 years with the Lake Champlain Basin program educating the next generation and helping people understand Lake Champlain management issues. Her work focused on grounding public messaging and all the program's work in science. Ms. Hickey started her career with EPA and pioneered new initiatives to help people understand the importance of protecting and restoring Lake Champlain. She worked with local media to develop "Champlain Connection," a news segment still running today, and she helped develop the Champlain Basin Education Initiative and its Watershed for Every Classroom program, which trains teachers in watershed education. She was also a driver of a social marketing campaign to reduce fertilizer use on residential property. The education and outreach team of the Lake Champlain program, which Ms. Hickey manages, connects with 35,000 people each year.

Government Award to the Vermont Aquifer Characterization Team, Bennington (Jonathan Kim, Vermont Department of Environmental Conservation; Peter Ryan, Middlebury College; Tim Schroeder, Bennington College; Edwin Romanowicz, SUNY Plattsburgh; David Boutt, University of Massachusetts, Amherst; Jamie Shanley, U.S. Geological Survey; David DeSimone, DeSimone Geoscience; and EPA New England's Marcel Belaval)

After an industrial plume contaminated with perfluorooctanoic acid (PFOA) in rock aquifers in the Bennington area affected several hundred drinking water wells, surface water, and sediment, this team of geologists, geochemists, and hydrogeologists from state and federal government, universities, and private business provided crucial interpretations and data to help the community understand and address risks, develop sites for monitoring wells, and determine the expansion of critical infrastructure to homes and businesses. The project improved the scientific foundation for PFAS policy and decision-making. The physical model allowed the team to determine the potential avenues for groundwater and PFAS transport in the bedrock and aquifers. Findings about groundwater ages are critical in understanding contamination patterns and safeguarding clean drinking water for the community and families.

Environmental, Community, Academia and Non-Profit Award to Seymour Lake Association, Morgan, for addressing high phosphorus levels that were largely caused by runoff from the densely developed shoreland and lack of shoreline vegetation. The state Department of Environmental Conservation encouraged the lake association to adopt shoreland protection measures to reduce runoff. Immediately, the Seymour Lake Association members encouraged shoreline residents to create buffers, plant vegetation, and improve drainage. The association also put in demonstration shoreland best management practices and held a tour to showcase the practices ultimately put in place at 35 sites. As a result, total phosphorus loading declined, and the lake now is free of invasive species. This lake is cited as an example of how lakeshore residents can reverse deteriorating water quality trends.

NEW HAMPSHIRE AWARD WINNERS

Lifetime Award to Barbara McMillan of Concord for her 30 years of educating communities and individuals to be better environmental stewards. During her career, Ms. McMillan led many programs including marine debris, pet waste, septic systems, stormwater, turf management, watershed planning, and water quality.

In 2012, she was central to establishing the state's highly successful Soak Up the Rain program, which helps homeowners manage stormwater runoff. To this day, the state's stormwater coalitions rely on Ms. McMillan's knowledge and ability to work with EPA to find solutions for complying with municipal stormwater permits. New Hampshire's environmental department and the thousands of people with whom she worked are indebted to her for her contributions to New Hampshire's environment.

Lifetime Award to Sarah Pillsbury of Concord for 35 years with the Department of Environmental Services and her commitment to environmental and public health protection during her career. She started out reviewing septic system designs and subdivision plans and soon became a manager and later administrator of the Drinking Water and Groundwater Bureau. She helped create strong programs

for small systems operation and management, source water protection, land protection, water conservation, large groundwater withdrawals, emerging contaminants, and private wells. During her career she also assumed leadership roles in the Association of State Drinking Water Administrators, the Ground Water Protection Council, and the National Drinking Water Advisory Council. Throughout her career, Ms. Pillsbury showed a commitment to environmental and public health protection.

Individual Award to Catherine Beahm of Merrimack for her leadership of the state response to the PFAS air emissions from the Saint Gobain performance plastics facility in Merrimack. She reviewed thousands of pages of company records to understand the impacts of the air deposition of PFAS to Merrimack, Litchfield, and Amherst. A 2019 state law authorized the Department of Environmental Services to regulate certain PFAS air emissions that contributed to groundwater contamination. An innovative approach, the statute required that the facility apply to the department to put in place the "best available control technology" to destroy PFAS emissions and demonstrate that emissions would not further contribute to exceeding groundwater standards. Though the facility had largely eliminated certain PFAS from operations, Ms. Beahm worked with EPA to identify hundreds more PFAS compounds remaining in facility emissions. While many states waited until federal agencies gathered information, Ms. Beahm expanded her own knowledge, becoming a national authority on PFAS emissions control. She has been the driving force in developing and issuing a historic air permit that allows Saint Gobain to continue operating while ensuring all known PFAS compounds are destroyed through advanced controls that prevent further groundwater contamination.

Individual Award to Annie Ropeik of Concord for environmental journalism including more than 200 stories in 2019 for New Hampshire Public Radio on environmental and energy issues, with more than 40 related to PFAS legislation, cleanup work, and public advocacy. She also regularly filed stories on Superfund site developments and clean water issues related to lead and arsenic in drinking water. Many of Ms. Ropeik's stories focused on New Hampshire-specific energy issues, climate science, and waste reduction. Her stories were accurate and fair, and often included several points of view. With fewer reporters across the country focused solely on environmental topics, Ms. Ropeik's work has been even more critical.

Individual Award to Michele Tremblay of Manchester for her unpaid role as president of the New Hampshire Rivers Council that restored the McQuesten Brook watershed to save a population of once thriving native trout in one of the state's most urbanized areas. In 2011, with no established watershed organization for the brook—a 6 in. (15.2 cm) deep pond known for its collection of shopping carts, tires, and muck—Ms. Tremblay led a crusade to restore McQuesten Brook and its watershed. The project removed four dams, eliminated a stream crossing, and upgraded a second crossing. The brook now flows freely after years of neglect.

CONNECTICUT AWARD WINNER

Non-profit Organization Award to Sustainable Connecticut of Willimantic, which under the leadership of Executive Director Lynn Stoddard has pioneered a state-wide program that helps municipalities improve the quality of life in their communities. The organization works with government representatives and community volunteers to protect the state's resources. A voluntary certification program, developed by the Institute for Sustainable Energy at Eastern Connecticut State University, recognizes Connecticut municipalities that meet a range of criteria to help them become more sustainable. So far, 94 communities—just over half the towns and cities in the state—are involved. Sustainable Connecticut communities build community and local economies, equitably promote the health and well-being of current and future residents, and respect the finite capability of the natural environment.

MASSACHUSETTS AWARD WINNERS

Lifetime Award to the Late Barbara Cianfarini of Pittsfield who for the past generation led Citizens for PCB Removal as a voice for the health of her Pittsfield neighbors and the Housatonic River. Her work contributed significantly to the comprehensive PCB cleanup in Pittsfield. After decades of General Electric's (GE's) use of PCBs in its Pittsfield operations, PCB contamination clearly encompassed the GE facility site and river, as well as dozens of homes that had used GE fill in foundations or backyards. Thanks to Ms. Cianfarini and the Citizens for PCB Removal's press releases through EPA, GE completed more than 200 residential cleanups and was required by the federal government to complete nearly 30 other cleanups of PCBs throughout Pittsfield and in the most highly contaminated stretch of the Housatonic River. She and the citizens group continued to prod EPA for 20 years, more recently focusing on the one remaining segment of the Housatonic River to be cleaned. Ms. Cianfarini demanded answers and solutions. For many years, she continued her advocacy while struggling with her own health. In November 2019, she passed away, but her consistent voice, methodical preparation, and core values of respect and kindness live on.

Lifetime Award to Patrick J. Sullivan of Springfield for his 33-year career building an environmentally friendly community and spearheading over $80 million in park construction projects. He helped improve lakes and ponds, and rebuilt dam infrastructure. He has established a technical environmental team for parks and buildings, overseen a green housekeeping and recycling program, introduced less toxic cleaning, maintenance, and curriculum products, established 20 organic school gardens, and launched an integrated pest management system in city buildings.

Over the past five years Mr. Sullivan has reduced hazardous substances in pesticides and conventional fertilizers used and has promoted evaluation of the effectiveness of organic land management, a program that has reduced runoff of pesticides and synthetic fertilizers. Mr. Sullivan also has helped both to clean Springfield's water bodies and to restore native habitats with a city management plan to reduce pollutant loads in water bodies, reopening them for recreational use.

Lifetime Award to Margaret VanDeusen of Boston who, as deputy director and general counsel for the Charles River Watershed Association for nearly 20 years before her retirement, helped build the association into a strong environmental advocacy organization. In a previous role at the Massachusetts Attorney General's office, Ms. VanDeusen worked with a team to take on polluters and restore degraded sites. At the watershed association, she fought for the public's right to access public trust lands, standing up to large, well-funded institutions to prevent privatization and ensure public access. Ms. VanDeusen used her litigation experience to bring an appeal when the Ipswich River was running dry, and issues raised by her and others led the state to update its drought management plan. Her knowledge of law and her diligence made her a formidable foe.

Individual Award to Mayor Daniel Rivera of Lawrence for his leadership and vision that have led to millions of dollars for Brownfields and response activities in the Arlington Street neighborhood; EPA Brownfield funds to help turn 1.4 mi (2.25 km) of the Manchester–Lawrence railway into a walking/cycling trail; a water strategy for the river; outreach events on litter and recycling; a "Water Bootcamp" where students learn about the water cycle and potential career opportunities; an urban park from a former industrial property; and planting of 2,000 trees in residents' yards to mitigate the city's heat island effect during summer.

Individual Award to Magdalena Ayed of East Boston, who as founder and executive director for the Harborkeepers has helped to create a community prepared for potential impacts of major flooding or storms. East Boston, with its unique geography, cultural diversity, and long relationship with maritime history, is particularly vulnerable to environmental and climate-related impacts. Harborkeepers provides free education to youth and adults about coastal issues and the impact of climate change. Over the last four years, under Ms. Ayed's leadership, Harborkeepers has worked with several local schools, housing developments, and community groups to address building resiliency in the community. Recognizing the impact of marine trash pollution around East Boston, Harborkeepers has held volunteer shoreline clean-ups since its founding. By the end of 2018, it had removed over 2,555 lbs (1,159 kg) of trash from the coastline.

Individual Award to Wayne Chouinard of Arlington for his environmental leadership as Arlington town engineer in providing a cleaner environment for citizens. During the past two years, Mr. Chouinard has been the primary town supervisor in collaborating with the Mystic River watershed to explore how communities can reduce nutrient pollution in stormwater discharges. In an EPA-led pilot project to better manage stormwater, Mr. Chouinard was dedicated to installing small-scale innovative stormwater controls to reduce phosphorus in discharges. His work resulted in a standard detail for an innovative infiltration trench retrofit. As a result, nine infiltration trenches installed in 2019 reduced nearly 1 lb (0.45 kg) of phosphorus and 1,296 gal (4,906 L) of runoff. Mr. Chouinard has continued to design and install economical, small-scale green infrastructure in Arlington. His

Brave Blue World Documentary Film Available on Netflix

The new Brave Blue World documentary, which paints an optimistic picture of how humanity is adopting new technologies and innovations for a sustainable water future, is now on Netflix.

Water Environment Federation the water quality people®

WEF is a production partner for the film, which is now available to an audience of 193 million worldwide Netflix subscribers and subtitled in 29 languages.

"It is important to convey a sense of hope for water and that is why WEF originally welcomed the opportunity to be a production partner for Brave Blue World," said WEF President Lynn Broaddus. "We are absolutely thrilled that this inspiring story of water can be seen by Netflix's global audience, and believe that by showing there is a path to a sustainable water future, Brave Blue World can help us to influence leaders, increase resources, change policies, and improve stewardship."

Narrated by Liam Neeson, the documentary includes interviews with various water experts, as well as activists Matt Damon and Jaden Smith. It features compelling stories, beautiful scenery, and novel ways of tackling water problems from across five continents. The film explores developments in water reuse, nutrient recovery, energy generation, decentralized treatment, and the digitalization of water. Brave Blue World also includes a segment and interview with Tom Kunetz, a WEF past president, at the world's largest nutrient recovery facility, the Stickney Water Reclamation Plant in Illinois.

"It's a great film and we all need to see it—every school and every college needs to see it," said Liam Neeson. "Every kid has heard of climate change; the film deeply connects with this. It makes water local, something so many of us take for granted."

Brave Blue World was produced by the Brave Blue World Foundation, in association with its production partners, which in addition to WEF include SUEZ Water Technologies & Solutions, DuPont Water Solutions, Xylem, L'Oreal, Aqualia, and the Dutch Water Alliance.

efforts helped spark a second round of municipal and agency collaboration in the watershed with four more communities that will likely result in green infrastructure throughout the watershed and a cleaner Mystic River.

Individual Award to Michele Paul of New Bedford who, as director of the city's Office of Environmental Stewardship, has seen unprecedented successes in leveraging Superfund restoration. In collaboration with the New Bedford Harbor Superfund team, she is leading the planning and construction of the riverwalk along the Acushnet River as well as the educating of residents to limit consumption of contaminated seafood. Ms. Paul has also led successful climate vulnerability evaluations, creating a plan that other communities can model.

Government Award to Massachusetts Department of Transportation Highway Division and Environmental Services of Boston for its Massachusetts Rivers & Roads Training program, aimed at creating more resilient infrastructure and protecting rivers. The program, part of the Department of Transportation's fluvial geomorphology program, has brought about a culture change in this agency. Those who attend the training learn how to reduce future damage through innovative design practices at locations of river–road conflicts. The trainings were modeled after a similar program in Vermont and have been replicated in all six Massachusetts highway districts, tailored to local issues, and adapted for towns and cities. The program promotes flood resiliency planning that saves money, protects the public, and reduces flooding and erosion. It also protects rivers and water quality while improving river habitat and has reinforced the proper sizing of bridges and culverts. It has brought together trainees from many sectors to change how the Department of Transportation and the state's transportation sector operate.

RHODE ISLAND AWARD WINNERS

Lifetime Award to Alicia Good, assistant director for water resources at the Department of Environmental Management, for her 37 years of directing programs critical to clean and safe water. She ushered in updated water quality regulations in 2006 that strengthened state water quality standards. Over her career, Ms. Good significantly improved water quality through water quality-based permits for wastewater treatment facilities and upgrades to infrastructure, including advanced treatment to reduce nutrient pollutant loadings to Narragansett Bay and its tributaries, as well as combined sewer overflow abatement. By 2012, nutrient pollutant loadings to the upper bay from 11 treatment facilities were cut in half, and dozens of overflows of untreated discharges in the Providence region were abated. Her leadership increased access for shellfishing and improved water quality that attracted recreational uses in waters once shunned. Ms. Good's dedication improved the quality of life for Rhode Islanders.

Lifetime Award to the Late Robert Stankelis, former manager of the Narragansett Bay National Estuarine Research Reserve, who for over 15 years developed the Research Reserve on Prudence Island in Narragansett Bay into the foremost location in Rhode Island for salt marsh research and a living laboratory for environmental education. His legacy includes the conservation of additional natural lands on Prudence Island to expand the reserve and enhance its programs. He brought partners together to protect over 225 ac (91 ha) of land, ensuring 85 percent of Prudence Island is protected in perpetuity. His improvements include beautifying the grounds with native plant gardens; replacing a derelict shed with a new education facility; constructing a new classroom building to accommodate school groups and expand education programs; and most important, expanding programs to make the reserve Rhode Island's leader in salt marsh ecology, long-term monitoring of estuaries, coastal training and meeting facilitation, and environmental education. Mr. Stankelis was widely respected nationally as a research reserve manager. He was collaborative in interactions with colleagues and was known as a quiet, thoughtful voice of reason who asked thought-provoking questions.

MAINE AWARD WINNER

Lifetime Award to Sharri Venno of the Houlton Band of Maliseet Indians in Littleton for establishing and developing the tribe's environmental program. One of the band's environmental priorities, a goal set by the Houlton Band of Maliseet Indians Tribal Council, was to re-establish Atlantic salmon to the Meduxnekeag River watershed. Nearly three decades later, Ms. Venno has not only advanced the band's environmental program and watershed restoration but also has represented her tribe and region in policy and collaborative problem-solving at all levels of government. For more than 20 years, Ms. Venno has represented the 10 federally recognized tribes in New England on the National Tribal Operations Committee.

In 1991, Ms. Venno published "Integrating Wildlife Habitat into Local Planning: A Handbook for Local Communities." She also has represented the Houlton Band and other New England tribes in the Gulf of Maine Council; the National Ocean Council—Regional Planning Body; the North Atlantic Landscape Conservation Cooperative Steering Committee; and the Northeast Regional Ocean Council—Ocean Planning Committee. She is a founding member of the Meduxnekeag Watershed Coalition and has helped to develop a Meduxnekeag Watershed Management Plan. Perhaps Ms. Venno's most impactful initiative has been to establish a collaboration to restore the Wolastoq/St. John River watershed, which extends into Canada. In 2015, her efforts resulted in U.S. and Canadian agencies convening, along with six Maliseet First Nations, to identify watershed restoration priorities, address fish passage concerns with Atlantic salmon as the keystone species, and develop a relationship among partners.

NEW HAMPSHIRE AWARD WINNER

Also, at the Merit ceremony, **Ronald Poltak of New Hampshire** was given the Ira Leighton "In Service to States" annual award for environmental achievement that has had an outsized impact in the state, the region, and nationally. The award recognized Mr. Poltak for his leadership of NEIWPCC for 37 years until his retirement in 2017.

Confronting racial inequalities in the water and wastewater industry

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ABSTRACT | As the nation further awakens to systemic racism, NEWEA members must actively identify opportunities to build a more inclusive environment for Black, Indigenous, and People of Color (BIPOC) in the water and wastewater industry. Diversity, not only of racial identity and ethnicity, but also gender, gender identity and expression, sexual orientation, socio-economic status, religious beliefs, age, and mental and physical ability, encompasses all that makes us unique (Eswaran 2019; Scott and Pozzi 2020). But it is inclusion—a measure of culture that allows diversity to thrive—that enables all individuals and groups to feel safe, respected, engaged, motivated, and valued (Mitjans 2019). Inclusive environments foster the diversity of thought, perspective, and experiences that allows an industry to excel (Eswaran 2019; Scott and Pozzi 2020).

Systemic racism, which refers to systems that perpetuate racial injustices, occurs in fundamental, powerful structures in the United States, including communities, educational systems, and the workforce (Collins 2018). This paper looks broadly at systemic racism against BIPOC and its impacts within these three structures as they relate to the water and wastewater industry, and suggests actions to dismantle the systems within them that perpetuate racial inequities. These suggested strategies are by no means comprehensive; they are provided to help empower NEWEA members and bring awareness to opportunities for building more inclusive environments in their respective communities, schools, and workplaces. While acknowledging and confronting white privilege and systemic racism can be difficult and complex, the industry cannot wait any longer to confront the nation's history of racial injustice.

KEYWORDS | Diversity, equity, inclusion, justice, racism, anti-racism

INEQUALITIES IN COMMUNITIES

Today, more than two million Americans lack access to safe drinking water and sanitation (Roller 2019). This challenge is not isolated only to individuals or households living "off the grid" but also affects entire communities. It is well-documented that households and communities of Black, Indigenous, and People of Color (BIPOC) disproportionately bear the burden of this inequity compared to white households: Indigenous households are 19 times more likely to lack access to complete plumbing, and Black and Latinx households are nearly twice as likely to lack access to complete plumbing (Deitz and Meehan 2019; Roller 2019).

How did this come to be? From the mid-1930s to the late 1970s, when significant federal investments were being made in water and wastewater infrastructure, the federal government also encouraged "redlining," the systematic practice of denying loans, investments, and services based on racial demographics (Roller 2019, Kenton 2020). Redlining excluded BIPOC communities from receiving adequate or equitable water and wastewater infrastructure. This, combined with many other consequences of redlining, created a negative feedback loop that left inequities in essential infrastructure still felt today (Roller 2019).

Today, federal funding is no longer the driving force behind water and wastewater infrastructure development; it has dropped from 63 percent in 1977 to less than 9 percent in 2019 (Patterson 2019). Nevertheless, BIPOC households, whose median income is less than two-thirds of white households, are still excluded from adequate water and wastewater services through their income (Peterson Foundation 2019). Most funding for infrastructure projects now comes from local ratepayers. This results in a problematic cycle: For a community to receive safe water and sanitation services, its residents must be able to afford these infrastructure replacement or improvement projects themselves. As a consequence, budget constraints in low-income communities often lead water or wastewater utilities to defer critical investments in upgrades and forgo regular maintenance.

Students from UMass Amherst join Chancellor Kumble Subbaswamy in celebrating the Engineering Community, Equity, and Inclusion Hub ribbon-cutting ceremony in January 2019 (UMass 2019)

ACTIONS FOR CHANGE IN COMMUNITIES

To effect change in communities, comprehensive data collection on water and sanitation access and support systems that provide comprehensive services for environmental justice communities are needed.

1. Collect comprehensive data on water and sanitation access

Unlike other countries, the United States does not collect comprehensive data on water and sanitation access, making it difficult to track progress toward goals. This is particularly true for BIPOC communities, which are notoriously undercounted in official datasets (McGraw 2019). More data need to be collected on disproportionate access to safe drinking water and wastewater services to determine exactly who in New England is living without toilets and taps. Without these robust datasets, developing equitable solutions to water and sanitation challenges within communities will be impossible.

Increased federal data collection and research will support the equitable allocation of federal resources and decision-making. For example, states must prioritize drinking water or wastewater systems with the highest health risk and the greatest financial need to receive support from the Drinking Water State Revolving Fund (DWSRF) or Clean Water State Revolving Fund (CWSRF), respectively. An EPA database allows states to identify Safe Drinking Water Act (SDWA) violations at drinking water systems, but the database does not track demographics of communities or whether they are considered low-income or disadvantaged (Schwartz 2018). Data collected from census boundaries on the demographics of communities do not overlap with water and wastewater service boundaries, and as a result, the scales of data collected are often incommensurable. Properly overlaying and comparing SDWA violations with demographic data would better reveal how race and access to clean water are related and would allow demographics to become useful in allocating federal resources equitably.

Increased data collection and research opportunities exist at the utility level as well. In greater Boston, where Black and Latinx households are disproportionately represented in the lower-income households, data have shown that water and sewer rates may already be unaffordable for many BIPOC households. Data collected from water shutoff notices revealed that thousands of residents are threatened with shutoffs to water service in Boston each year, and a "strong, persistent" relationship between race and water access exists, even after controlling for the average income of the neighborhood (Heudorfer and Korman 2017; Foltz-Diaz et al. 2019). As data related to race and water access become more mainstream and accessible, utilities such as the Boston Water and Sewer Commission (BWSC) that are committed to remaining flexible with assisting customers experiencing financial difficulties, can develop bill payment assistance programs targeted at racial inequities to water access (BWSC 2020).

2. Support systems that provide comprehensive services for environmental justice communities

Environmental and public health inequities disproportionately affect BIPOC communities in New England (CLF 2020). While laws and regulations may provide comprehensive services for environmental justice communities in writing, there must be systems in place to hold communities accountable for their implementation. The support of these systems can help to undo the damage caused by decades of redlining. Below are two examples of

A 2.7 ac (1.1 ha) former Brownfield in Lawrence, Massachusetts, had been abandoned for nearly 20 years before neighborhood planning identified the site as key to local community revitalization. One hundred percent of Lawrence is classified as an Environmental Justice community according to Environmental Justice population data from the 2010 Census developed by the Massachusetts Executive Office of Energy and Environmental Affairs. The park was finished in 2006 and includes picnic areas, garden beds, and a playground.

policies and their resulting actions that aim to ensure that all people benefit from the equitable distribution of environmental benefits and are protected from environmental burdens regardless of where they live or work.

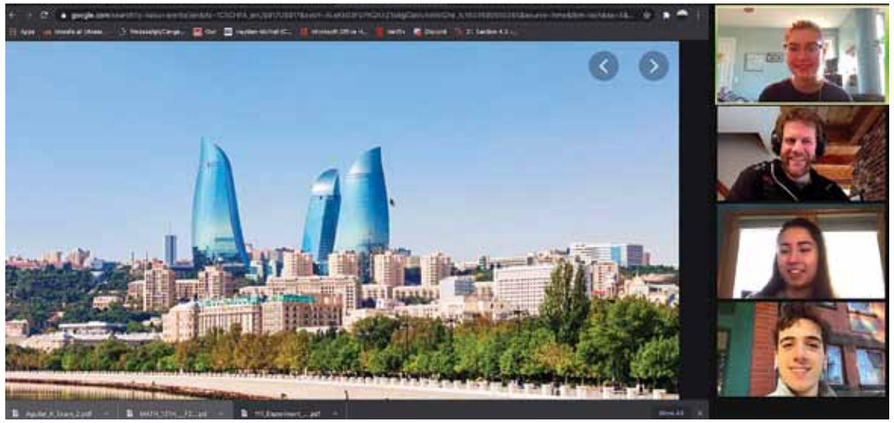
In Massachusetts, a 2002 report entitled *Unequal Exposure to Ecological Hazards: Environmental Injustices in the Commonwealth of Massachusetts* led to the adoption of the state's first environmental justice policy and program (Faber and Krieg 2002). The resulting program clearly defines an Environmental Justice Population in Massachusetts (which includes communities where 25 percent or more of the residents identify as a race other than white) and works with the identified communities' stakeholders to ensure that funding is available to develop, implement, and enforce environmental laws and regulations (Mass.gov 2020A). As a result of this program, the City of Lawrence has made great strides in inclusive community revitalization. In 2006, the city unveiled a new, 2.7-acre (1.1 ha) park on a former Brownfield site in the middle of a large, dense neighborhood. Prior to its installation, few recreational green spaces existed for residents of the neighborhood to enjoy (Mass.gov 2020B).

More recently, the City of Boston declared racism an emergency and public health crisis (City of Boston 2020A). As a result of this executive order, 20 percent of the police overtime budget is being reallocated into a new community-based task force that will work toward increased equity in public safety and public health, and create lasting, systemic changes to help eliminate racism and inequality. On the long list of action items, the task force plans to analyze data to better understand the interconnectedness of societal, environmental, and behavioral factors that contribute to the impact of racism and access to jobs, food, housing, transit, and education (City of Boston 2020B).

INEQUALITIES IN EDUCATION AND ACADEMIA

While BIPOC students are beginning to have an equitable representation in some degree programs, they are exceedingly underrepresented in the degree programs that directly feed into the water and wastewater industry—primarily engineering and environmental science. Black Americans make up about 13 percent of the U.S. population, yet they represent only 4 percent of engineering bachelor's degree recipients and 2.6 percent of engineering faculty; the statistics are equally dire for Indigenous and Latinx Americans (Chang 2015). Some underlying reasons for the underrepresentation of Black Americans in engineering programs can be attributed to a lack of encouragement to pursue engineering and science from an early age, limited access to equitable education and resources prior to college, and discrimination in college recruitment, retention, and promotion (Funk and Parker 2018; NSC Research Center 2015). Without role models in the industry, many BIPOC students may never even consider pursuing a career path in water or wastewater.

Unfortunately, the problem runs deeper than unequal backgrounds and cannot be entirely explained by the underlying reasons above. Research has shown that, even when socio-economic disparities are not considered, Black students are still more likely than white students from the same socio-economic background to transfer out of an engineering major, or leave college without a degree altogether (Riegle-Crumb et al. 2019). Universities' retention policies unintentionally benefit white students and the characteristics of their culture, while Black students are left behind (Jones and Okun 2001). The onus should not fall on Black students to make changes so that they may succeed in engineering degrees. Universities need to reevaluate retention policies and change their educational culture to make learning accessible for all students.



Professor Nick Tooker discussing how differences and similarities in students' backgrounds and experiences can affect the design process as he helps his students with their semester project of incorporating civil engineering design and sustainability into a building project. Students had to include cultural and geographic considerations to determine design differences and similarities if their building was situated in an alternative location from Amherst, Massachusetts. This assignment was part of the UMass Dean's Diversity, Equity, and Inclusion Curriculum Challenge. Pictured is a team considering alternative locations in Baku, Azerbaijan (from top to bottom: Rachel Perrotta, Nick Tooker, Karalynn Aguilar, and Elvin Kadi).

ACTIONS FOR CHANGE IN EDUCATION AND ACADEMIA

Changing education and academia to benefit underrepresented students calls for supporting mentorship opportunities from an early age and creating equitable, supportive learning environments as well as incorporating diversity and inclusion into higher education's culture and curriculum.

1. Support opportunities for mentorship of underrepresented students from an early age

The water and wastewater industry can support non-profits that engage underrepresented youth groups with engineering and environmental science from an early age. The National Society of Black Engineers (NSBE) and Black Girls Code are two excellent national organizations active in New England. NSBE, which aims to increase the number of culturally responsible Black engineers who excel academically, succeed professionally, and positively affect the community, offers a pre-college initiative program for youth in K-12 to participate in various engineering competitions and activities (NSBE 2020). Black Girls Code, which aims to empower young girls of color to become leaders in technical fields, offers similar programs for girls to brainstorm and develop ideas as a team (Black Girls Code 2020).

At the national level, the Water Environment Federation (WEF) has created a new scholarship program, InFLOW (Introducing Future Leaders to Opportunities in Water), to enhance diversity and inclusion in the water workforce (WEF 2020).

Creating partnerships with organizations such as NSBE, Black Girls Code, or the InFLOW program can be a useful and effective recruiting strategy for universities and companies, while also providing underrepresented students with access to mentorship, scholarships, and internships. Opportunities for individuals to support underrepresented students include participating in engineering outreach events, contributing to scholarship/internship funds, or volunteering to mentor students through similar organizations like the ones described above.

2. Create equitable, supportive learning environments for underrepresented students

Research has found that Black students in engineering fields are more likely to advance professionally if their university's culture is welcoming and sets clear, well-articulated expectations and structure (Fisher et al. 2019). The Engineering Diversity and Outreach Center (EDOC) at the University of Connecticut (UConn) and the Office of Equity and Inclusion at the University of Massachusetts (UMass) are two examples of how universities have incorporated institutional changes to create a more inclusive and welcoming experience for BIPOC students.

UConn's EDOC facilitates the recruitment, retention, and overall success of all members of the UConn College of Engineering community, but especially those from backgrounds traditionally underrepresented in engineering. This group includes underrepresented minorities, women, and first-generation college students. The Engineering Ambassadors Program is one such successful program hosted through EDOC. It started 10 years ago with 10 university students interested in building

a stronger and more welcoming engineering community at UConn and has grown to include more than 200 students (Freund 2020). Through this program, students help run prospective student tours, participate in outreach in local, middle, and high schools, and support on-campus activities, while developing valuable leadership and professional skills. EDOC also provides students with resources for practicing anti-racism, facilitates educational discussions on inequality and racism, and works to listen to, support, uplift, and educate students in the UConn engineering community (UConn 2020).

Similarly, the Office of Equity and Inclusion at UMass College of Engineering supports the recruitment and retention of diverse students in engineering through academic, professional, and personal support programs, collaborations with faculty and staff, industry, alumni, and local communities, and collaborations with national organizations working to increase opportunities for underrepresented students. The office has recently started a new initiative, *Engineering the Gap—Building Bridges for Students from Holyoke/Springfield to UMass STEM.* Through this initiative, UMass will expand and deepen its support of K-12 partners in Springfield and Holyoke, two neighboring communities designated by the state as environmental justice populations, build a pipeline for underrepresented students from these communities to UMass College of Engineering, and ensure professional development opportunities for these students once they arrive on campus (UMass 2020A).

3. Incorporate diversity and inclusion into the culture and curriculum of higher education

In addition to addressing how universities can evolve to create more inclusive environments, equally important is recognizing the deeper biases that the cultures of universities uphold. While all students confront intense pressures on their time, energy, endurance, and organizational abilities, underrepresented students face additional challenges and pressures to complete engineering degrees (McGee, Griffith, and Houston 2019). Professors must become aware of the unique needs of BIPOC students, including setting clear structures and expectations in their classrooms and research groups. Ultimately, professors are integral to building a more supportive and inclusive environment within colleges and universities, and they must be provided with the proper tools so that underrepresented students can prosper in engineering programs.

An increasing number of universities are formalizing programs related to diversity and inclusion for their professors. Diversity, equity, inclusion, and implicit bias trainings for faculty are steadily becoming ubiquitous, and faculty mentoring programs are gaining traction (USC 2016). Incentives are also being developed for professors to incorporate diversity, equity, and inclusion into their teaching curriculum. For example, in the fall semester of 2020, the UMass Amherst Office of Equity and Inclusion launched the Dean's Diversity, Equity, and Inclusion Challenge in response to students' requests to see issues of diversity, equity, inclusion, and racial justice embedded in the engineering curricula. For this challenge, every faculty member in the College of Engineering was asked to submit at least one lesson plan for one class taught during the semester that incorporated these ideas (UMass 2020B). By first equipping professors with the proper tools to confront diversity, equity, and inclusion issues head-on in the classroom, professors can then educate students about the ongoing impacts of white privilege and systemic racism within the nation and give them the tools to undo them.

INEQUALITIES IN THE WORKFORCE

In the United States, less than 8 percent of water and wastewater treatment plant and systems operators are Black (DATAUSA 2020). Similarly, less than 8 percent of environmental engineers are Black (DATAUSA 2020). Combined, these BIPOC operators and engineers disproportionately represent the lower- and middle-of-the-line positions (EEOC Diversity Report 2016). In other words, Black employees are disproportionately underrepresented in the water and wastewater workforce; and those who do enter the industry are much less likely to advance to senior positions than their white counterparts. These patterns can largely be explained by the impacts of systemic racism felt in communities and educational structures, as discussed above.

In the workforce, systemic racism manifests itself in numerous ways, starting with the application and interview process and persisting over the lifetime of one's career (OED 2020). While some acts of blatant racism experienced by BIPOC are motivated by hatred, others can occur without conscious awareness or intent (Livingston 2020). Non-inclusive environments such as these can limit the range of perspectives, approaches, and skill sets needed to tackle increasingly complex water and wastewater problems across New England. There is a growing need for talent throughout the industry, and to meet the industry's goals of providing safe and equitable services, the NEWEA community must continue to listen to and amplify diversified voices.

ACTIONS FOR CHANGE IN THE WORKFORCE

Actions that will help change the workforce include recruiting from diverse networks, creating equitable opportunities for advancement and compensation, and demonstrating a commitment to anti-racism, along with a subsequent plan of action.

NEWWA's Annual Planning Session held in July 2020 brought 55 participants together for panel and small group discussions to learn from each other and brainstorm barriers to achieving a more diverse and inclusive industry, as well as actionable solutions and suggestions on how to move NEWWA forward

1. Recruit from diverse networks

Racial discrimination not only plays a part in the recruiting and hiring processes; it also influences even being considered for a position. This barrier is fundamentally about siloed networks. One-third of all jobs are estimated to be obtained through family, friends, or colleagues (Abowd et al., 1999). Since most social networks are racially homogeneous, it is especially easy for white people to exclude people of color from their networks. For the remaining two-thirds of jobs, experimental evidence has shown over and over again that resumes with white-sounding names are much more likely to receive interview requests than equally qualified resumes with Black or Latinx-sounding names (Gerdeman 2017; Bertrand and Mulainathan 2004; Gaddis 2017; Nunley et al. 2014).

For the industry to become more diverse, organizations must proactively recruit from diverse networks. Recruiters can focus on universities and community colleges with higher numbers of BIPOC students and specifically reach out to associations that support BIPOC students, such as NSBE, the Society of Hispanic Professional Engineers (SHPE), or the American Indian Science and Engineering Society (AISES). Further, employers can make sure they are not making the minimum qualifications for a position unnecessarily exclusive. For example, making a selection criterion only about academic achievements such as graduating in the top 5 percent of the class may not realistically capture the entire pool of graduating students, and may not fully identify a candidate's potential achievements and value. To echo the words of Booker T. Washington, the educator, author, activist, and presidential adviser, "Success is to be measured not so much by the position that one has reached in life as by the obstacles which [one] has overcome while trying to succeed."

Many organizations in New England have created events for networking and learning that promote diversity and inclusion. For example, the American Council of Engineering Companies (ACEC) hosted a free online class in August 2020, "Diversity & Inclusion Keys to Success: Design Professionals Coalition's (DPC) Playbook on ACEC Firms' Best Practices," which provided an overview of a report published by the ACEC DPC Diversity and Inclusion working group. The report includes information on how to evaluate and modify processes such as talent acquisition, management, and development to be more equitable and inclusive. In January 2020, ACEC Rhode Island hosted a free diversity networking forum in Providence, and 160 people attended the event. Thirty Rhode Island certified disadvantaged business enterprise (DBE)/women business enterprise (WBE)/minority business enterprise (MBE) firms were invited to exhibit and present their services (ACEC 2020). Networking events such as the ACEC–Rhode Island Diversity Networking Forum can be helpful for participants to discuss projects and collaboration opportunities, and can help organizations looking to hire outside their typical networks.

2. Create equitable opportunities for advancement and compensation

Diversity, equity, and inclusion programs are not one-size-fits-all; actions to promote fair opportunities in workplace advancement may work well in one organization but not in another. However, many organizations can benefit from identifying areas of improvement. Organizations can conduct internal research and collect data to identify areas of possible bias, such as compensation or promotion. Identifying and mitigating these potential areas of

bias can tremendously help an organization succeed; research shows that organizations that prioritize and invest in diversity benefit from increased profitability and better problem-solving compared to organizations that do not invest in diversity (Eswaran 2019). Another possible way to evaluate an organization is to hire an external firm to conduct an equity analysis, which would provide company-specific feedback and recommendations including qualitative and quantitative analyses, individual interviews, and human resources data collection and evaluation (Frankel 2015). It is important also to identify key metrics for tracking the results and progress of any actions taken (Lewis 2015). Developing quantitative metrics for measuring success is essential in determining the effectiveness or success of any initiatives related to diversity and inclusion. Metrics can facilitate employee buy-in for the initiatives and inform decisions regarding necessary changes or adjustments. Potential metrics include examining pay equity to determine if/how applicable groups are represented across various wage levels and tracking varying demographic groups as they advance within the organization (Suarez 2019).

Organizations can also pre-determine requirements for promotion to ensure equitable opportunities for advancement. While white employees are more likely to be evaluated based on their expected potential, BIPOC employees are expected to repeatedly "prove" their value and capabilities (Carter 2020). This often leads to BIPOC employees, especially Black women, being promoted solely based on their results, while white employees are promoted on their expected potential. To avoid this bias, organizations could commit to an initial list of requirements for a promotion and then require a detailed explanation for waiving any of the conditions (Lewis 2015).

3. Demonstrate a commitment to anti-racism, along with a subsequent plan of action

Many organizations have recently issued statements of support for Black lives, condemning all forms of racism. In June 2020, NEWEA pledged that it would do its part to address systems of inequity and build a more inclusive water and wastewater sector:

> The recent killings of George Floyd, Breonna Taylor, and Ahmaud Arbery are painful examples of the systemic racism and violence inflicted upon Black and Brown individuals and communities across our nation, as well as beyond our borders. NEWEA condemns these acts of violence against people of color and stands in solidarity with those grieving these losses and peacefully protesting for equality, reform, and justice. We are working to listen, provide support, and learn. It is important that we educate ourselves about the systems in place that disproportionately and adversely affect Black communities and other communities of color, including systems that limit access to quality healthcare and education; suppress voting rights; and enable violence against Black and Brown individuals and communities. NEWEA is committed to supporting equality and social justice. We all have a lot of work to do to create a more equitable future for ourselves, our communities, and our next generation, and it will be through working together at the local, state, and federal levels that positive change will happen (NEWEA 2020).

Public statements, such as NEWEA's above, show an organization's support and solidarity for BIPOC and those fighting systemic racial injustice. However, organizations must develop a plan to put action behind these words and include target dates along with a budget and measurable items of success in that plan. To keep progress moving, NEWEA has established an ad hoc Diversity, Equity, and Inclusion Committee to ensure a welcoming environment for all members where everyone feels empowered, valued, respected, and safe. The committee plans to facilitate a panel and roundtable discussion on confronting racial inequalities in the water and wastewater industry at the upcoming NEWEA Annual Conference. Later in 2021, the committee plans to spearhead an environmental justice-themed edition of the *Journal*.

WORKING TOWARD A MORE DIVERSE, INCLUSIVE, AND EQUITABLE FUTURE

Many other individuals and organizations within the water and wastewater industry have continued to demonstrate their commitment to improving diversity, equity, and inclusion. The WEF Workforce Diversity and Inclusion Task Force, the American Water Works Association (AWWA) Diversity and Member Inclusion Committee, and the New England Water Works Association (NEWWA) Organizational Diversity Committee have all been working toward making their spaces more diverse, equitable, and inclusive.

Ultimately, confronting inequalities and creating a more inclusive industry are challenges that all leaders must meet within their respective organizations. Think critically about how you can use your power to effect change in your communities, schools, and workplaces. What can you and your organization do to promote equity and activate meaningful change? Whether you are a senior or junior leader, how can you advocate for such action and ensure that all voices are heard? Every individual in the water and wastewater industry has a role to play meeting this goal. Let us continue these difficult conversations about diversity, equity, and inclusion as we strive to make the industry more diverse, equitable, and inclusive.

If you are interested in becoming involved with the newly formed NEWEA Diversity, Equity, and Inclusion Committee, please contact NEWEA at mail@newea.org.

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Tackling stormwater pollution from contemplation to implementation—doing the right thing

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ABSTRACT | Town of Arlington Town Engineer Wayne Chouinard's leadership is advancing a new standard of stormwater practice for small-scale, affordable stormwater controls in Massachusetts. By collaborating with EPA, the University of New Hampshire Stormwater Center, and the Mystic River Watershed Association, Mr. Chouinard has developed a new standard detail for an innovative infiltration trench retrofit. Since 2014, Arlington has installed 31 of these systems and plans to install 20 more next year. Nutrient removal performance curves show that these systems can significantly remove phosphorus in the appropriate context. The work has sparked collaborations with surrounding communities that are focused on advancing green infrastructure throughout the watershed and revitalizing the Mystic River, considered impaired by phosphorus since 2007.

KEYWORDS | Stormwater, infiltration, nutrient removal, performance curves, Arlington, MS4, Mystic River watershed, green infrastructure

Wayne Chouinard, Arlington town engineer, inspects an infiltration trench chamber

DOING THE RIGHT THING

"They're really just holes in the ground." Wayne Chouinard is being both accurate and modest as he describes the infiltration trenches that helped earn him an Environmental Merit Award from EPA Region 1 this fall.

It is true that "Wayne's drains," as they are known among his colleagues, are just ditches, some open and vegetated, some beneath the surface. To focus on the simple structure, however, is to overlook the art, one that Chouinard has honed since he became the town engineer of Arlington, Massachusetts, in 2011.

Under his leadership, infiltration trenches have become a new standard of practice for Arlington. The design and installation of each is informed by the ones that came before. As a result, this network of cost-effective, small-scale stormwater controls is reducing the flow of phosphorus and other pollutants off the landscape, helping Arlington comply with its new Municipal Separate Storm Sewer System (MS4) permit and contributing to a revitalization of the Mystic River and its watershed.

"This approach is only workable when you have local champions like Wayne who collaborate and innovate to solve problems," says Newton Tedder, senior permit writer, EPA Region 1. "His environmental leadership has provided a cleaner, healthier environment for the town's citizens and the watershed as a whole."

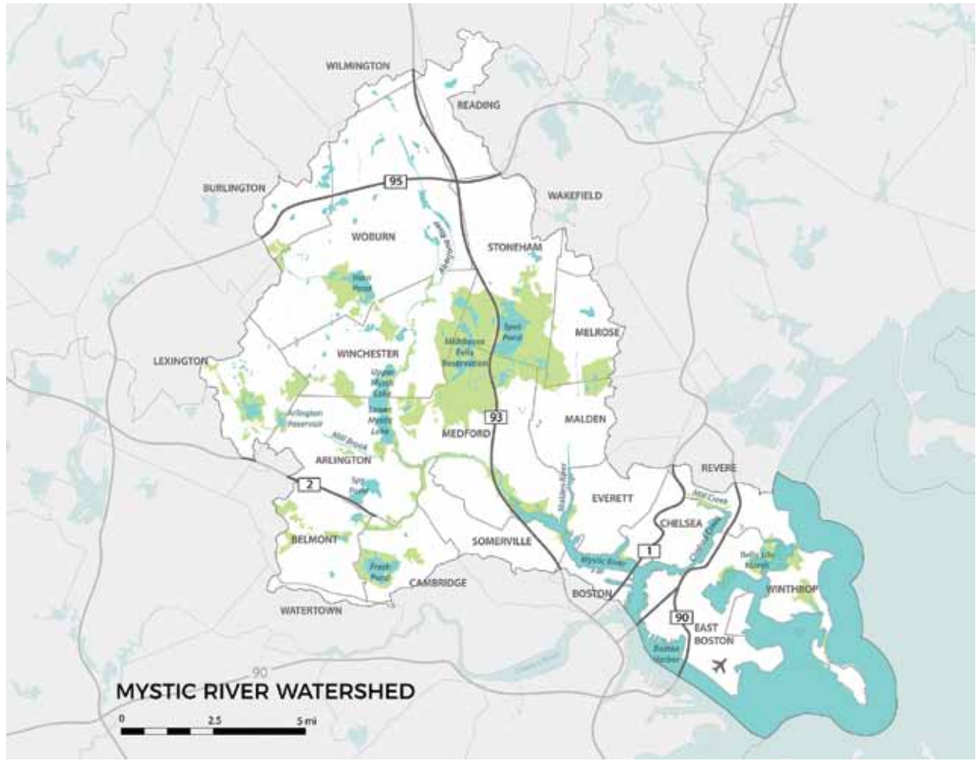

Figure 1. Overview of the Mystic River Watershed—one of the great urban rivers of New England, the Mystic has become the focus of a federal, state, municipal, and non-profit partnership committed to improving water quality and environmental conditions and creating open space and public access

New Career, New Partners

Mr. Chouinard began his career in home construction in the 1990s. From there, he transitioned into consulting, reviewing site plans for municipalities. Moving from building to plan review and from the private sector to the public, there has been one constant in his career.

"The hobby part of engineering for me has always been hydrology—I'm fascinated by runoff calculations," laughs the Natick, Massachusetts native. "When I came to Arlington, I wanted to know, How can I do more of that stuff?"

At the time, little was being done with stormwater at the municipal level. Old regulations were driving the standard of practice and contributing to municipal projects that, as Mr. Chouinard describes it, "went awry." There was opportunity for change, but in Arlington's compact urban landscape, there was not much space or money for new ideas.

The best advice Mr. Chouinard received at the time was to educate other people and himself. He started an informal series of talks on stormwater, inviting others to give presentations. He began to collaborate with the Mystic River Watershed Association (MyRWA), a non-profit that promotes water quality and environmental preservation, and he eventually joined the Mystic River Watershed Steering Committee.

Together with his new colleagues, he began to write grants to pay for some of the ideas they generated. Several of these were funded by EPA. This enabled Mr. Chouinard to meet people in the association, who quickly transitioned from being "those regulators" to becoming "my co-workers."

"Once I started working with all of these groups, I could see that we were all peers in the Mystic River," Mr. Chouinard says. "They probably could see my passion for all of this, and I liked theirs. Before I knew it, it had flourished into a great working relationship."

Small-scale, Affordable, and Effective

Mr. Chouinard's connections eventually led him to work with the University of New Hampshire Stormwater Center (UNHSC), a research, testing, and educational facility that serves as a technical resource for water managers, planners, and design engineers around the country. Together, they collaborated with EPA on a pilot project to explore

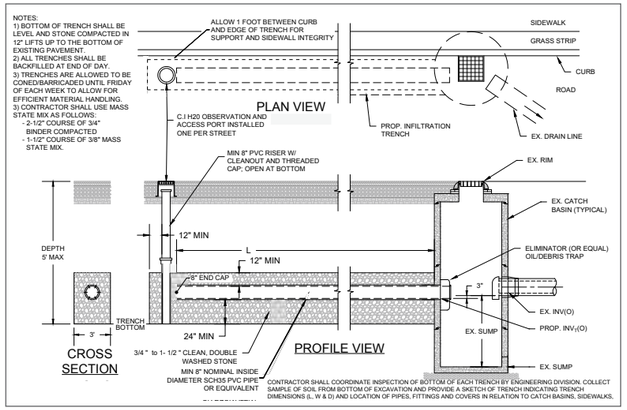

Figure 2. Design detail and specifications for the infiltration trenches

Table 1. Modeled costs and infiltration trench performance*

Unit	Cost ($)
System	2,200
IC treated per acre (per ha)	18,857 (44,000)
TP per lb (per kg)	24,750 (55,000)
TN per lb (per kg)	3,930 (8,609)
TSS per lb (per kg)	86 (190)
Volume eliminated per cf (per m^3)	0.11 (4)

*Based on the EPA's cost memo and the Massachusetts MS4 permit Appendix F

how Arlington and neighboring Winchester could reduce nutrient pollution, specifically phosphorus, in stormwater discharges.

"We put our heads together to see what we could do that was small scale and affordable," Mr. Chouinard explains. In Arlington's urban landscape, infiltration trench retrofits made sense (see Figure 2).

UNHSC scientists provided performance curves for pollutant load reductions for the proposed trenches; these turned out to be essential for tracking their effectiveness. UNHSC scientists continue to monitor one of the installation sites to refine the curves (see Figure 3).

"Before they formalized the nutrient removal numbers, I didn't know how much these designs could achieve," says Mr. Chouinard. "Having that spreadsheet gives us something to point to, to show we are making progress and can track it. People don't question it because it's from the UNH Stormwater Center."

Since 2014, Arlington has installed 31 infiltration trenches. In 2019 alone, the town installed nine systems for less than $20,000 (Table 1), with an annual reduction of nearly 1 lb (0.45 kg) of phosphorus and 1,296 gal (4,906 L) of runoff across the nine 2019 installations.

"Working with Wayne was effortless," observes UNHSC Director Dr. James Houle. "Stormwater management is increasingly focused on expensive, high-yield engineered controls. Wayne knew there was another option—an 'everyday' approach in which the town could make improved stormwater management part of the culture. Now, infrastructure improvements routinely include stormwater improvements. This do-it-yourself attitude will not only save the river but also will help the town and taxpayers avoid higher costs in the future."

New Standard of Practice for the Watershed

Over six years, Mr. Chouinard has adjusted the trench detail to incorporate what they learn and adapt it to new sites. They have found that connecting the trenches to existing catch basins lowers installation costs. The first systems were

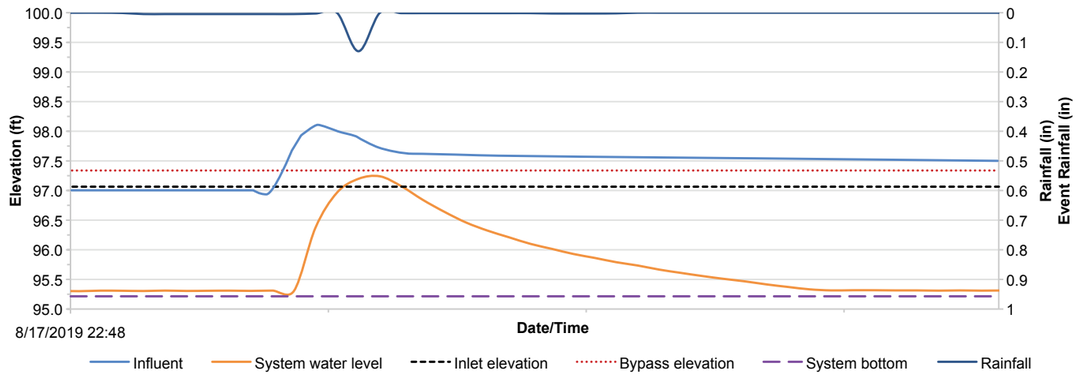

Figure 3. Monitoring results from one of the installed trenches: water level (blue) entering the system; small peaks above the bypass (red-dotted line) indicate overflow. Everything below the bypass line indicates infiltration into the ground, yielding volume and pollutant reductions.

Alongside infiltration trenches, Arlington has employed other small-scale stormwater control systems, including (left to right) porous pavement, rain gardens, and updated outfalls

installed under pavement, but they determined it was more practical to sometimes divert the flow into open grassy areas. Sandier subgrade soils are more likely to increase phosphorus uptake and being selective about where the trenches are installed can significantly increase the impact of the investment.

Nuances like these are contributing to a new standard of practice for Arlington, the bar for which keeps getting a little higher.

"Every year we have another collaboration that pushes us forward, and every single year we learn something new," says Mr. Chouinard. "I try to document it all so anyone can pick this up. I wanted to make this scalable and easy for a young engineer and other communities to implement."

This approach has prompted neighboring towns to learn more and incorporate some of the low-cost nutrient reduction strategies used in Arlington. Mr. Chouinard is often called on to give presentations for other communities and national webinars, and he is happy to do so, even though "the most fun is when I get to put something in the ground. I just really love my job."

"Wayne jumped into this work with enormous creativity, energy, and enthusiasm," says Andy Hrycyna, watershed scientist with MyRWA. "The designs he worked to develop are being rolled out across the watershed. It's a great testament to what can happen when agencies and municipal officials engage in collaborative conversation."

It is also a testament to how one great idea can attract significant funding for watershed improvement. MyRWA recently received a $498,715 grant from the Massachusetts Department of Environmental Protection to build 50 more trenches in Arlington and in nearby Medford and Winchester in the coming years.

The end game? A revitalized Mystic River where people can enjoy boating and fishing, one with healthy wetlands that support wildlife and provide other benefits. Mr. Chouinard sees the path for this laid out in the town's MS4 permit as the way to get there.

He predicts that "over the next 20 years, we will see progress and it will all be steered by the permit. We need to keep putting in these systems, tracking their effectiveness, and changing our approach based on what we learn. We can't just keep repeating the past; we need to do the right thing."

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- Dolores Jalbert Leonard is founder of Roca Communications, a woman-owned, strategic communications firm dedicated to positive social and environmental change. She delivers communications solutions and facilitates co-learning experiences for organizations focused on advancing clean water, healthy ecosystems, and resilient communities.

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Integrating green and gray infrastructure in the most densely populated city in New England—stormwater mitigation in Somerville, Massachusetts

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ABSTRACT | The City of Somerville, Massachusetts, is embarking on major infrastructure upgrades that will change the way it manages much of its combined drainage system. This multifaceted program includes macro improvements to stormwater conveyance, storage, and pumping as well as green stormwater infrastructure incorporated into the public realm and private developments. The Somerville Avenue Utility and Streetscape Improvement (SAUSI) project, one of the first within this program, includes the installation of more than 2,000 lf of 14 by 6 ft (610 m of 4.3 by 1.8 m) precast concrete box culvert, 4,500 lf (1,370 m) of combined and sanitary sewer cast-in-place pipe lining, and a significant incorporation of green infrastructure into the new, "complete" streets design. The new gray infrastructure will provide 860,000 gal (3,255,400 L) of stormwater storage, while the new green infrastructure will provide not only stormwater storage for 1.5 in. (3.81 cm) of runoff from the contributing drainage area but also reduce impervious surfaces, expand the urban forest, and improve the quality of the downstream water bodies.

KEYWORDS | Stormwater management, sewer separation, complete streets, green infrastructure, bioretention, tree cells, pervious pavement

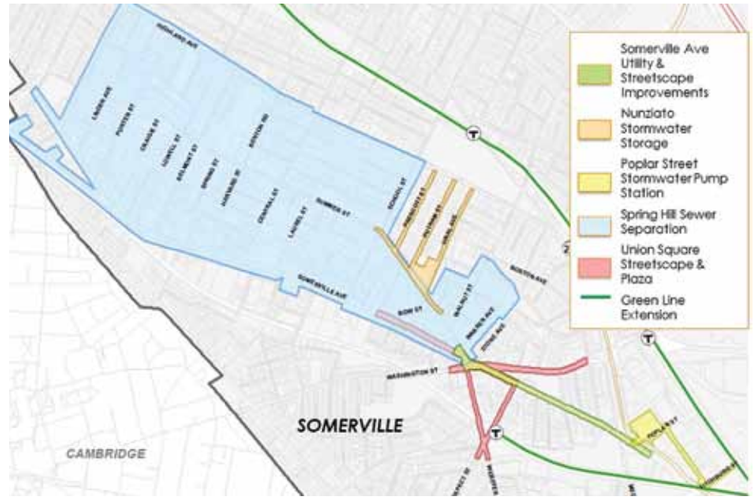
INTRODUCTION

The Somerville Avenue Utility and Streetscape Improvements (SAUSI) project is the first in a series of stormwater mitigation projects that will change how the City of Somerville manages much of its combined drainage system. Currently, the city's conveyance system relies on the capacity-limited Massachusetts Water Resources Authority (MWRA) wastewater collection system. This results in frequent, sometimes catastrophic flooding in Union Square and surrounding neighborhoods. Flooding is expected to intensify as climate change increases the likelihood of powerful rainstorms. The SAUSI project will alleviate flooding in Union Square (one of Somerville's key commercial centers and location of many minority-owned small businesses) and several surrounding neighborhoods that continually experience flooding.

The greater stormwater program will incorporate sewer separation in additional upstream neighborhoods, a 1.6 MG (6.1 ML) storage tank at Nunziato Field, a 1.5 MG (5.7 ML) storage tank and pump station on Poplar Street at Somerville's ArtFarm for Social Innovation, and green infrastructure. The program has also taken advantage of a unique opportunity for the City of Somerville to partner with the Massachusetts Bay Transit Authority (MBTA), which is extending the Green Line light rail transit system from Boston through Somerville ("the GLX project"). As part of the GLX project, MBTA has installed new drainage infrastructure that discharges into Millers River. As a condition of the city's financial contribution to the GLX project, Somerville can discharge up to 50 mgd (189 ML/d) per day of stormwater from the Poplar Street pump station to the MBTA drainage system. Through this unique partnership, Somerville will regain access to a historical stormwater outfall that serves the Millers River and Union Square watersheds, while supporting critical transportation upgrades that improve all transportation modes.

The City is committed to making its streets green by promoting sustainable and low-maintenance designs through materials, plantings, and drainage while simultaneously improving city utilities, roadways, and sidewalks to maintain safe and fully accessible streets. The SAUSI project, under construction, will create the trunk line of the drainage system with the installation of over 2,000 lf of 14 by 6 ft (610 m of 4.3 by 1.8 m) precast concrete box culvert and a complete streets design on the surface that prioritizes safe use by all modes—pedestrians, transit users, bicyclists, and motorists. The complete streets project includes major improvements to the stormwater infrastructure, a state-of-the-art cycle track, and a roadway and streetscape restoration that incorporates green infrastructure solutions for stormwater management.

Upgrading nearly all utilities in this corridor, both private and public, and incorporating drainage pathways that mimic more natural systems were no small feat during the planning, design, and construction phases. This project is expected to be complete in the fall of 2021.



Locus map of SAUSI project, the greater stormwater program, and the GLX project

BACKGROUND

Somerville is within the Boston metropolitan area, west of the Charles River. Geographically, Somerville is a city of seven hills, the product of glaciation. These drumlins generally run west to east and define the pattern of the city's stormwater runoff. Before the late 1800s, runoff was predominately overland.

In the late 1800s, two events dramatically affected stormwater runoff, and the resulting runoff patterns remain to the present date. The first was development in and near Union Square, resulting in the filling in of much of Millers River and its floodplain. Second, with the loss of a receiving waterbody, the city undertook a combined sewer construction program. Union Square became the convergence point of most of the combined sewers before they headed into the Charles River. By 1895, the city engineer realized the 72 in. (1.82 m) diameter combined sewer east of Union Square did not have the capacity to manage high-intensity storms and recommended a major relief conduit and other storm drains; however, this program was only partially implemented.

Today, Somerville has a population of over 80,000 within an area of 4.11 mi² (10.6 km²), with a population density of nearly 20,000 people per square mile (7,700 per km²). It is the most densely populated municipality in New England and ranks 16th in the United States (Ref. 1). This high density of development produces high rates of runoff.

Such runoff resulted in the Union Square flood of July 10, 2010, after a high-intensity, short-burst storm. A subsequent city study (Ref. 2) identified the need for many improvements, particularly increased conveyance capacity and approximately 4 MG (15 ML) of stormwater storage.

While these macro improvements are the traditional approach to stormwater mitigation and can handle most of the runoff volume, the application of green infrastructure is a cost-effective, complementary strategy that also improves stormwater runoff quality, reduces the heat island effect, and improves air quality, among other benefits.

July 10, 2010 flood in Union Square

In 2013, the City solicited proposals for the design of the Union Square utility and transportation study and project. The objective was to develop a program of traffic, streetscape, stormwater, and utility improvements to address deficiencies while supporting a new transit station in Union Square and related transit-oriented development (TOD).

The selected design team had developed both gray and green infrastructure improvements to address issues of flood control and stormwater quality. Construction began in 2018.

WORK REPORTED, METHODOLOGY, AND RESULTS

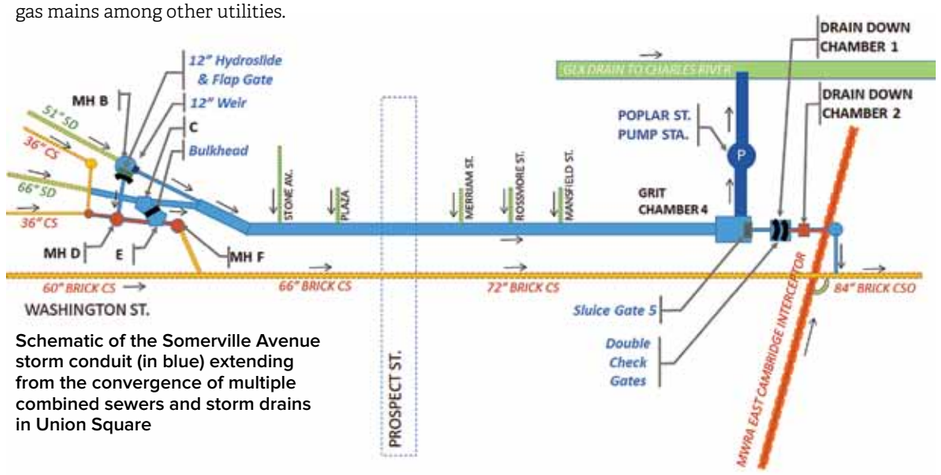
Integration of a stormwater box culvert in this dense urban street was no small feat. However, the design team found that the footprint for the conduit first envisioned in 1895 was, miraculously, still largely available between Union Square, the nexus of flows for much of the city's combined sewage, and the downstream connection point with the MWRA near the McGrath Highway. The design team laser scanned the city's brick combined sewer to determine precise extents and condition of the pipe. The brick sewer's footprint was nailed down, and its condition was in good shape; after a review of various technologies, lining was recommended and performed (cured-in-placed pipe lining for the up to 84 in. [2.13 m] diameter brick sewer).

The most complex designs included the upstream connection structure at Union Square, where a 51 in. (1.3 m) storm drain, two 36 in. (91 cm) combined sewers, a 66 in. (1.7 m) storm drain, and a 60 in. (1.5 m) brick combined sewer all converge under a regionally important intersection, a downstream connection structure with an MWRA connection and a future connection to the Poplar Street pump station, and a crossing of Prospect Street that includes high voltage electric and twin 36 in. (91 cm) high-pressure gas mains among other utilities.

Green infrastructure implementation on an urban streetscape uses vegetation and porous surfaces to capture, store, and infiltrate stormwater to reduce runoff from transportation infrastructure, filter out pollutants, and reduce the burden on gray infrastructure and treatment facilities. Looking beyond the stormwater management benefits when compared to gray infrastructure, green infrastructure provides economic, environmental, and social benefits. Economic benefits can include increased property values; environmental benefits can include reduced urban heat islands and improved air quality; and social benefits can include improved public health and enhanced passive recreation amenities.

The City of Somerville considered several objectives when selecting the segment of Somerville Avenue between Washington Street and Medford Street for its first green infrastructure streetscape program. Green infrastructure design goals included providing a diverse selection of stormwater best management practices (BMPs) well-suited for the area, designing stormwater storage for 1.5 in. (3.8 cm) of runoff from the contributing drainage area, reducing impervious surfaces, and expanding the urban forest by maximizing tree plantings and soil for the trees.

Early on, the SAUSI project team evaluated topography, street slopes, utilities, street tree health, historic geotechnical borings, and soil data. Extensive utility requirements, sidewalk and accessibility requirements, vehicular and cyclist traffic patterns, and expectations of providing functional solutions and aesthetic enhancement to the streetscape all informed the green infrastructure design. The strategies implemented included porous asphalt surfacing for the proposed raised cycle track; permeable concrete unit pavers for the buffer areas on both sides of the cycle track; bioretention basins; stormwater and traditional landscape planters; and street tree plantings with a modular suspended pavement system both to support tree growth and provide stormwater management.



Schematic of the Somerville Avenue storm conduit (in blue) extending from the convergence of multiple combined sewers and storm drains in Union Square

The overall streetscape impervious area was reduced by 0.7 ac (0.3 ha), 12 percent of the project area. This was achieved by maximizing the area of porous asphalt, permeable concrete unit pavers, and landscape planter areas. The green infrastructure systems on average provide stormwater storage for 1.5 in. (3.8 cm) of runoff from their contributing drainage area with 25 percent of the project area captured.

The bioretention basins are landscaped depressions that typically extend into the street and collect, treat, and infiltrate stormwater runoff. Stormwater is directed to the basin and then percolates through the vegetation and an engineered soil media, providing water quality treatment and volume reduction or attenuation through infiltration to subgrade soils. Stormwater planters resemble

Rendering of sidewalk cross-section showing stomwater planter

bioretention basins, but they are usually narrower and linear in comparison to basins. Four bioretention basins and three stormwater planters are being constructed as part of the SAUSI project. Historic geotechnical boring and soil data indicated that the subsurface materials in these locations are primarily sand and loamy sand (as categorized in Natural Resources Conservation Service [NRCS] Hydrologic Soil Group A), which typically have high infiltration rates. On-site subgrade soil infiltration tests at the basin locations confirmed high infiltration rates.

Porous pavement comes in various materials. The SAUSI project selected porous asphalt in the raised cycle tracks and permeable concrete unit pavers in sidewalk buffer strips. The porous materials share a bedding of clean, double-washed crushed stone for storage and infiltration into the subgrade soils. An elevated underdrain with the stone bedding allows for infiltration below, while collecting and conveying stormwater flows and larger storm events to the storm sewer main. An approximately 2,830 ft (863 m) of 6.5 ft (2.0 m) wide porous asphalt cycle track and 9,000 ft² (837 m²) of permeable concrete unit pavers will be installed.

Bioretention basin—installation of crushed stone layer with perforated underdrain, cleanout, and overflow structure, (right) bioretention soil

More than 50 new street trees will be planted along the streetscape corridor. Tree species such as elm, hackberry, oak, linden, and planetree were selected to maximize tree canopy, maintain species diversity, incorporate native species, and plant durable, resistant, resilient, and low-maintenance trees. Important to both the tree planting design and the stormwater management approach was a soil cell system. Soil cells are a modular suspended pavement system for containing large amounts of soil beneath paving while supporting loads above

Paver installation crew sweeping the joint filler stone into the spaces between the pavers. Infiltration testing performed after sweeping the joints verified that the installation met the specified infiltration rate. (right) Closeup showing the 1/4 in. (0.64 cm) stone used for joint filler.

Soil Cell installation: (1) Worker carefully spaces the bases on the aggregate subbase. Once the spacing is verified, the base plates are nailed into place. (2) Posts have been installed, six posts to each base plate. (3) Strongbacks installed to restrain the posts while planting soil is placed within the cell and stone is placed outside the cell. (4) Strongbacks replaced by decks. Crushed stone placed over the planting material.

and accommodating surrounding utilities. The City evaluated multiple options for increasing soil volume including suspended pavement systems, an alternate commercial composite structured stone and soil system, and sand-based structural soils. The soil cell system that maximized soil volume within a limited space was chosen.

The soil cell system allows for large, contiguous, continuous volumes of planting soil, maximizing tree growth potential and capacity for treating stormwater onsite. Where achievable, soil cells were used to connect multiple trees with a single, larger contiguous volume of soil thereby maximizing available root zone per tree. The soil cells chosen are in two sizes, a 15.2 ft^3 (0.43 m^3) cell and a taller 28 ft^3 (0.795 m^3) cell, with both sizes to be used to create the necessary root zones. Almost 800 of these soil cells, providing approximately 16,700 ft^3 (473 m^3) of soil volume, will be installed as part of the SAUSI project. When integrated with the stormwater management system, soil-cell contained soil provides absorption, evapotranspiration, and interception of stormwater runoff. Other benefits include improved water quality through higher removal rates of dissolved nutrients, hydrocarbons, and total suspended solids (TSS). Most of the suspended pavement surfaces above the soil were designed as porous asphalt cycle track and permeable concrete unit pavement to promote infiltration of stormwater throughout the entire root zone and provide air exchange.

At two locations along the streetscape corridor, bioretention soil instead of traditional planting soil was placed within the soil cell system. Stormwater runoff from the street is directed to the system catch basins and through porous pavement above. Once inside the soil cells, stormwater runoff is intercepted by the tree and evapotranspired or infiltrated into the soils below. These practices are referred to as stormwater tree trenches. The stormwater tree trenches are approximately 145 to 175 ft (44 to 53 m) long by 16 ft (5 m) wide.

DISCUSSION

Major utility construction for the SAUSI project began in the spring of 2018. The green infrastructure work along with the roadway subgrade and curbing installation work did not start until the spring of 2020. The SAUSI team met early on to discuss submittals, sequencing, and key elements to consider when installing green infrastructure, which is a specialty construction very different from typical drainage, roadway, and landscape construction.

In late March 2020, construction shut down under Massachusetts Governor Baker's COVID-19 order. Construction resumed in mid-May, with proper health and safety plans and Massachusetts COVID-19 construction guidelines and procedures in place. Work began on the soil cell system and stone bedding installation that would form the base for the porous asphalt cycle track, permeable concrete unit pavers, sidewalk, and tree planters. Increased communication among team members with several socially distanced on-site, and virtual meetings around green infrastructure helped mitigate challenges on a fast-paced, ever-changing construction site.

Construction of the north side of Somerville Avenue was completed first, moving west to east from Washington Street to Medford Street. The material supply and sequencing of green infrastructure installation were a challenge. The team navigated unprecedented material supply hurdles as production of the soil cell system, pavers, and crushed stone were affected by COVID-19-related shutdowns.

The green infrastructure construction sequencing was challenging where the cross section from the face of roadway curb to the right-of-way limit consisted of a bioretention basin, porous asphalt cycle track, tree planter, and sidewalk in that order. The roadway curb installation proceeded down the north side of the street corridor first; the soil cell and tree planter work followed, and then the bioretention basin work began. Owing to the integrated nature of the design and for an easier installation, the cross section could have been constructed at the same time with each layer incrementally brought up to grade.

The team also had to adjust to the seasonally related aspects of green infrastructure construction. For example, green infrastructure work cannot proceed when subgrades, soils, and planting soils are in a wet, muddy, or frozen condition. The porous asphalt cycle track installation depends on meeting specific ambient air and ground temperatures with seasonal calendar restrictions. Also, many batch plants require an order of a minimum quantity of porous asphalt, since it is a specialty material that requires separate production from traditional asphalt and production demand is less.

Temporary asphalt has been placed for the cycle track with porous asphalt paving anticipated in the spring of 2021. Tree and perennial vegetation planting seasons must also be considered. The soil cells and planting soils were installed, with the tree planting expected to take place in 2021. Similarly, the soils for the landscape planters and bioretention basins were placed, but vegetation will also be planted later.

Until vegetation is planted and established, temporary mulching of all the planters and bioretention basins and blocking or installing stone and silt sock dams at basin surface inlets to prevent erosion and reduce sediment are required. Construction has now shifted from the north side of Somerville to the south side. After the necessary subsurface infiltration testing was completed, free draining soils, the soil cell system, and stormwater planter excavation and installation are expected to continue for as long as the weather allows.

In summary, the key to successful green infrastructure installation is planning. This starts with early coordination among the contractor, engineers, construction inspectors, and landscape architect to review the details, installation methods, and environmental constraints for each element of the streetscape. Construction must start from the bottom and proceed upward. Installation of light pole bases, handholes, drainage structures, conduit, and irrigation systems must be sequenced with the construction of the green infrastructure.

CONCLUSIONS

Design considerations, on-site implementation, and projected effectiveness of the green infrastructure systems demonstrate how innovative approaches to science, engineering, and ecology can concurrently resolve infrastructure challenges while enhancing the environment. With construction underway and anticipated to finish in 2021, the project will show the successful integration of an attractive, sustainable streetscape design using engineered solutions for stormwater management and pollution reduction.

ACKNOWLEDGMENTS

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Lessons learned from 20 years of illicit discharge detection and elimination in Massachusetts

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ABSTRACT | The new Massachusetts Small Municipal Separate Storm Sewer System (MS4) General Permit includes significantly increased requirements for Phase 2 permittees within the illicit discharge detection and elimination (IDDE) program. Several communities in Massachusetts have been conducting robust city-wide IDDE efforts prior to the current permit requirements. This paper discusses the regulatory requirements in the EPA New England MS4 General Permit, New England-based IDDE investigation protocol, lessons learned through field experience, the challenges municipalities can expect during program development and implementation, and critical tips to streamline program execution. Additionally, the paper discusses logistical and safety challenges in implementing IDDE implementation during COVID-19.

KEYWORDS | Stormwater, MS4, illicit discharge detection and elimination, field test kits, outfall inspection


Conducting field analyses using a test kit

INTRODUCTION

The 2016 Massachusetts Small Municipal Separate Storm Sewer System (MS4) General Permit, which became effective on July 1, 2018, includes significantly increased and prescriptive requirements for Phase 2 permittees within the illicit discharge detection and elimination (IDDE) program. EPA Region 1 has focused on IDDE as a major regulatory initative, based in part on the development of IDDE programs in Boston as an early adopter and Phase 1 community, and through several enforcement orders for other communities throughout the commonwealth. EPA has reported that during the past 30 years in greater Boston, through correction of aging and incorrrectly connected sewer systems, that more than 800,000 gpd (3,000,000 L/d) of untreated wastewater has been eliminated from stormwater drainage systems draining into the Charles River and Boston Harbor.

The Massachusetts and New Hampshire programs require traditional outfall screening and sampling but expand requirements to include comprehensive drainage system investigations using grab samples and field sample testing for illicit indicators. While the programs are clearly needed to protect public health in New England communities, these new regulations present a challenge for many communities and represent an aggressive regulatory model already being considered in other New England states and across the Northeast.

IDDE concerns generally include direct and indirect discharges that compromise stormwater by introducing non-stormwater fluids or other contaminants into the drainage system. Examples of indirect discharges include failed sanitary sewer collection mains or laterals, hazardous waste spills, and illegal dumping. Direct discharge refers to any non-stormwater pipe connected to stormwater drains, such as sewer laterals or septic system overflow and washing machine or floor drains. It is critical for communities to find and eliminate points of illicit contamination, but without the correct tools, sufficient guidance, and a structured program, it can be a very inefficient process.


Web-based GIS Collector application for mapping and data management

EPA NEW ENGLAND IDDE APPROACH

Original IDDE program guidance was developed by the Center for Watershed Protection and Robert Pitt *(2004, Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments).* This guidance was used and refined in the *EPA New England Bacterial Source Tracking Protocol, Draft 2012.* EPA Region 1 developed the new IDDE protocol in 2012 based on years of experience in Boston and in enforcement cases in other non-Phase 1 communities.

The protocol describes factors that can be reviewed via desktop analysis to prioritize outfalls or to identify locations for field investigation. These criteria include the following areas: that discharge to critical or impaired waters (e.g., water supplies, swimming beaches); served by common/twin invert manholes; with sewer underdrains; with inadequate levels of sanitary sewer service; with a history of sanitary sewer overflows (SSOs); formerly served by combined sewer and have subsequently been separated; and densely populated areas with older infrastructure.

Once priority areas for investigation have been identified, the protocol emphasizes the use of rapid visual and olfactory inspections as well as field test kits (for ammonia, surfactants, and chlorine) and laboratory sampling (for *E. coli* or *Enterococci*) during dry weather to isolate the source(s) of contamination in segments of the drainage system. The extensive research that EPA has conducted in enforcement communities has focused on these four parameters as the most likely to indicate a possible illicit discharge. The field test kits may be used without laboratory sampling while conducting field reconnaissance. This removes the need for laboratory coordination and holding times, reducing costs and allowing nimbler sampling. Once dry-weather investigations are complete, the guidance suggests a similar investigation approach during wet weather to identify issues not observed during dry weather.

Under previous MS4 permit requirements, IDDE implementation guidance was less prescriptive. The 2003 MS4 permit in Massachusetts and New Hampshire simply required a "program to detect and eliminate illicits," conduct outfall mapping, and develop procedures. There were neither quantitative requirements nor prescriptive guidance on sampling requirements. Cities and municipalities largely relied on opportunistic reporting by citizens, and construction or maintenance crews and programs varied widely in implementation protocol. Prescriptive permit requirements now reduce the uncertainty of program elements but still require an understanding of field-based assessment approaches to be efficient.

Structured IDDE program implementation by one consultant team in several New England communities has resulted in the discovery of approximately 475 direct illicit discharge connections and approximately 500 indirect illicit discharge connections. These results came through careful program execution and, as with most new programs, some experimentation. Technology, data management, field methodology (particularly an adjustment in investigative approach), and effective work in winter weather all help streamline IDDE programs.

OUTFALL INSPECTION PROCESS

Initial outfall screening includes a visual and olfactory inspection consistent with Chapter 11 of the Center for Watershed Protection's *Illicit Discharge Detection and Elimination: A Guidance Manual for Program Development and Technical Assessments* (2004). Screening inspections are conducted during dry-weather conditions and are documented through digital data collection or paper forms. EPA Region 1 defines dry-weather conditions as no more than 0.1 in. (0.254 cm) of rainfall in the previous 24-hour period and no significant snowmelt. It describes wet-weather conditions as a precipitation event that consists of sufficient flow to produce a stormwater discharge.

If flow is observed during screening, two samples are collected from the outfall (or if the outfall

Table 1. EPA-defined benchmarks for illicit indicators	
Indicator Parameter	**Benchmark Concentration**
E. coli/Enterococci	Receiving water criteria
Surfactants (as MBAS*)	≥ 0.25 mg/L
Ammonia (NH3)	≥ 0.5 mg/L
Total chlorine	> 0.02 mg/L – method detection limit

*Methylene Blue Active Substances

is inaccessible, the nearest accessible upstream drainage structure) in accordance with EPA's *Draft Bacterial Source Tracking Protocol* (2012). One sample is analyzed in the field for ammonia, chlorine, surfactants, conductivity, salinity, and temperature; the other sample is submitted to a Massachusetts-certified laboratory to be analyzed for *E. coli* or *Enterococci*. Under the 2016 MS4 permit, for specific outfalls that "discharge directly" into impaired waters, additional laboratory or field testing may also be required depending on the impairment. Benchmark concentrations, defined by EPA and provided to guide the potential for illicit cross-contamination, are included in Table 1. If flow is not observed during screening, the non-flowing condition is noted on the Outfall Inspection Form and no sample is collected.

Both dry-weather and wet-weather screening may be necessary to identify outfalls and interconnections with illicit discharges. Under the MS4 permit in Massachusetts and New Hampshire, wet-weather screening is also required in drainage areas that exhibit so-called system vulnerability factors (SVFs). These factors may include the following, and have been defined in the MS4 permit by EPA:

- Repetitive SSOs
- Common or twin-invert manholes serving both storm and sanitary sewer
- Sewer pump/lift stations, siphons, or known sanitary sewer restrictions where power/equipment failures have resulted in SSOs
- Sanitary sewer alignments known or suspected to have been constructed with an underdrain system
- Extensive and documented sanitary sewer infrastructure defects such as leaking service laterals, or cracked, broken, or offset sanitary infrastructure
- Widespread code-required septic system upgrades required at property transfers (indicative of inadequate soils, water table separation, or other physical constraints of the area rather than poor owner maintenance)

Under the MS4 permit, permittees will need to inspect, screen, and possibly sample all outfalls from the MS4 during the first three years of the permit term.

OUTFALL PRIORITIZATION PROCESS

The MS4 permit obligates an outfall prioritization process. All outfall "catchments" must be delineated within the first year of the permit and then prioritized based on various factors in the permit. Often communities will have available data only for a subset of these factors and prioritization generally includes the following:

- Land use
- Parcel density
- Sewer pipe/stormwater drainage pipe crossing
- Sewer age
- Receiving/impaired waters status

Figure 1 outlines a typical prioritization approach that assigns outfalls to one of four EPA-defined categories.

INVESTIGATION PROCESS

One of the biggest changes and largest impacts on level of effort to comply with the 2016 MS4 permit in Massachusetts and New Hampshire is associated with the prescriptive investigation procedure requirements. These requirements greatly expand the obligations for permittees.

The investigation procedure includes the following implementation steps:

1. Conduct a preliminary review of drainage plans, GIS mapping, and record plans to define the specific catchment area for the catchment to be investigated. Once an approximate catchment area is defined, identify known SVFs within the catchment as defined by the MS4 permit to determine the need for wet-weather outfall screening.
2. Distribute notifications to residents and property owners within the investigation area to inform them of the potential need to gain access to private property to inspect municipal drainage infrastructure and internal plumbing, and/or conduct dye testing.
3. Conduct catchment investigations during dry weather. Conduct a visual and olfactory inspection of key junction manholes in the drainage area to attempt to identify obvious source(s) of illicit cross-connection, inflow, or infiltration. A key junction manhole allows effective assessment of upstream drainage. Typically, but not always, begin investigation in the upper portion of each catchment working downstream. If visual evidence of a direct illicit discharge is identified and the segment of pipe can be isolated, skip to Step 5.
   - When flow ***is observed*** in a key junction manhole, use field kits to analyze samples for ammonia, chlorine, surfactants, conductivity, salinity, and temperature, and record results. Junction manholes with obvious signs of contamination (e.g., toilet paper) do not need to be sampled.
   - When flow ***is not observed*** in a junction manhole, partially block each inlet of the manhole using sandbags or other barriers for a 48-hour dry period (i.e., when no precipitation or significant snowmelt is expected). Reinspect the junction manhole after 48 hours for intermittent flows and then sample any captured flow for standard sampling parameters.
4. Isolate the pipe or open drainage segment thought to contain illicit discharge(s) using "bracketed" field sample collection for standard sampling parameters.
5. Conduct additional investigations, as needed, before or after "bracketed" field sampling to verify the source(s) of pollutants. These investigations typically include CCTV pipe inspections of nearby sanitary sewer and/or targeted internal plumbing inspections via lateral tests using dye flushing and/or sanitary sewer collection system dye flooding.
6. When illicit discharge locations are verified in association with a physical address or indirect interconnection with the sanitary sewer (e.g., surcharged or leaking sanitary sewer), field staff will photograph the problem area at ground level, identify any other indicators of location, summarize the likely remedy to the problem and sampling results, and forward this information to the program manager. The program manager will then initiate the corrective action process.

Under the MS4 permit, permittees will need to complete investigation of all their MS4 during the first 10 years of the permit term, unless they have "problem" catchments, which must be completed in the first seven years. For many communities this obligates the visual inspection and potential sampling of thousands of manholes and can only be conducted in dry weather, complicating logistics.

SMART FIELD APPROACHES

A smart field approach is tailored to a community's needs and asset condition, with each IDDE investigation beginning with some prioritization and systematically working through the entire drainage system. This typically means beginning at the system's upper reaches and working downstream. This is known as the top-down approach. However, occasionally the process begins at outfalls and works systematically upstream (bottom-up approach).

Regardless of the starting point, every key junction drainage system manhole within the MS4 drainage network must be investigated and is selected to isolate a discrete "upstream" drainage network. This method allows the team to isolate contamination

Excluded

- Catchments with no potential for illicit discharges and may be excluded from the IDDE program. This category is limited to roadway drainage in undeveloped areas with no dwellings and no sanitary sewers; drainage for athletic fields, parks, or undeveloped green space and associated parking without services; cross-country drainage alignments (that neither cross nor are near sanitary sewer alignments) through undeveloped land.

Low Priority

- Catchments determined by the permittee as low priority based on outfall/interconnection screening and/or catchment characteristics, and that are not classified as High Priority, Problem, or Excluded

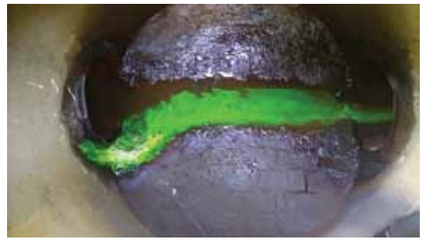
High Priority

- Outfalls discharging to an area of concern for public health due to proximity of discharges to public swimming areas or drinking water supplies; or catchments determined by the permitee as high priority based on the following:
  - Latest approved Integrated List Waterbody segments defined by MassDEP as bacteria impaired waters
  - Outfalls that discharge into swimming areas
  - Outfalls receiving a prioritization scoring in the top 50 percentile

Problem

- Catchments with outfalls/interconnections with known or suspected illicit discharges based on existing information; includes areas where screening indicates sewer input (olfactory/visual evidence of sewage), ammonia ≥0.5 mg/L, surfactants ≥0.25 mg/L, bacteria ≥receiving water criteria, detectable chlorine

Figure 1. IDDE prioritization categories



Visual evidence of sanitary sewage in a stormwater manhole from a direct illicit connection

Gray filamentous algae in seepage at a pipe penetration in a stormwater catch basin often indicate indirect illicit connections

to short segments of pipe, often narrowing down the source of contamination to a single run between two manholes. Once possible contamination has been isolated, dyed water testing of adjacent buildings' plumbing is usually the next easiest step to pinpoint the source of contamination. If dye testing does not provide conclusive results, additional tools, such as bacterial tests, DNA testing, and CCTV inspections may be necessary.

The COVID-19 pandemic has changed how catchment investigations must be handled. Key junction manhole inspections have not changed dramatically, but the increased use of personal protective equipment (PPE) is necessary (facemask always, face shields while sampling water, extra hand sanitizer, etc.). The standard approach to dye testing previously involved notifying building owners and then making "cold-call" visits. With the pandemic this is not an option. Not only do we want to keep inspectors and the community safe, but the efficiency of this practice has dramatically decreased. To work around this, more scheduled appointments are required. This enables crews to ensure COVID-19 safety protocols are in place and that no one in the household is ill. Another adaptation is the creation of dye-testing kits for residents that include dye-tracing tablets that they can flush themselves and follow-up surveys to gather the information on plumbing fixtures tested. If residents allow, plumbing inspections can be done via video using relatively inexpensive cameras. This will allow continued progress while protecting public health.

Experience in the field has yielded several lessons learned or "tips and tricks" that can improve the investigation. Perhaps most important is that, while a good plan is essential to efficient fieldwork, the plan must evolve based on field conditions. Rigidly following a list of manholes to inspect can mean that crews will need to return later to conduct additional investigations to isolate the origin of an issue. Being flexible and adjusting the approach in the field may be more time-consuming during the initial investigation, but it will cut down on return visits and save time in the long run.

Traffic control is also important for catchment investigations. Regulations and guidance will vary from community to community and so too will each plan. The logistics of accessing and entering manholes in urban communities, however, requires a carefully structured plan for notifying the police and other municipal public safety parties.

When dye testing, experience has shown that multiple fixtures should be tested. The common assumption is a single-family residence will have only one sewer discharge. This is often not true and even when it is, testing different fixtures can produce different results.

Recording anecdotal observations during investigations is also important. If soap is found flowing into the drain and a house up the street is doing laundry, make a note of that because it is likely the source. If flow picks up right after someone arrives home, that is valuable information. Has there been recent utility work on a street? That often leads to lateral infrastructure damage. Does a building have a large tree in front of it? The roots may be causing issues in the sewer lateral. All this anecdotal information can paint a clearer picture of what is going on.

Another important lesson learned is to conduct verification as quickly as possible after contamination has been isolated whenever possible. Moving quickly after discovering an issue improves the likelihood of locating the source of contamination. The longer the delay between the initial discovery and the verification, the greater the possibility that conditions will change and that isolating the source will be more difficult.

Finally, focusing IDDE near areas with known sewer issues is a successful strategy. Sewers known to be typically surcharged or in poor condition are one of the biggest indirect contributors to contamination in drainage systems.

IDDE INVESTIGATIONS AND WEATHER

In New England, weather is one of the most important and complicating factors in meeting the MS4 permit schedule. As IDDE investigation is primarily conducted in dry weather, using all dry-weather windows and minimizing the fouling of sandbags by unexpected rainfall are important. Setting a risk threshold for probability of rainfall is helpful as it can remove some of the subjectivity in go/no go decisions. A typical risk threshold is 50 percent chance of precipitation, but this will vary by community. Some municipalites would rather miss opportunities than risk redoing work because of rainfall. When using a risk threshold, hourly precipitation probabilities are important because the daily probabilities are not sufficiently accurate.

Traditionally, IDDE investigations are conducted during the construction season. However, dry-weather catchment investigations are feasible in winter. In addition to watching for precipitation, snowmelt as well as the known interaction between detergent test kits and salinity also must be considered. High levels of salinity can create false positives in surfactants test kits. Steps must be taken to mitigate this interaction when possible. The new MS4 permit timelines are daunting and working only in spring and fall will hamper schedule adherence.

LEVERAGING NEW TECHNOLOGIES

From our perspective, the field efforts at the heart of these investigations must incorporate mobile, web-based, real-time reporting and data management software to streamline data management and to increase transparency across municipal departments and/or with outside contractors. During the investigation phase, field teams may apply as many as 30 data points to each drainage system manhole and/or pipe segment, with hundreds of manholes and pipes accessed during investigation. Real-time data collection and reporting also allow a nimbler way to adjust drainage system mapping errors in the field. Real-time editing to system maps can be done on the fly with subsequent QA/QC from the office. The evolution and availability of web-based digital field data collection and mapping programs are essential to future IDDE program success.

EXAMPLE FINDINGS

While conducting investigations, several scenarios are often encountered. The easiest sources of contamination to pinpoint are direct illicit connections. Visual evidence (fecal matter, abundant soap suds, clumps of toilet paper, etc.) often reveals a direct illicit connection to field crews. Direct illicit connections can be from a single home or building or in more extreme cases the sanitary sewers from streets or sections of streets that are accidentally connected to the storm drain system. Direct connections are typically verified through dye flushing from adjacent building plumbing fixtures, with dye quickly seen in a downstream stormwater manhole or catch basin.

For indirect illicit connections, identification and verification of their sources can be much more difficult. They are usually identified by positive field tests (ammonia and/or surfactants), but occasionally more severe cases will have some visual evidence. Under these circumstances the visuals are typically toilet paper particles or soap suds. Indirect illicits can be from broken, surcharged, and/or leaking building laterals or from defects in the sanitary sewer infrastructure in the streets or when sewers cross through storm drains (yes, this happens). Leaking sewer laterals will often be indicated when dye flushing is evident in both the sanitary sewer and the storm drain downstream of the problem property. This may require field staff to wait for up to an hour to determine if there are leaks from private building laterals.

Surcharged sanitary sewer lines can also be the source of intermittent, indirect illicit connections and can often be quickly identified during field investigations through quick checks of adjacent sewer manholes.

CONCLUSION

Compliance with the Massachusetts MS4 permit, and particularly the IDDE program, is a significant challenge for many communities, and careful planning and thoughtful execution of inspections is essential in meeting permit obligations. The existing guidance, supplemented by extensive field experience from Phase 1 communities and previous enforcement actions, enables us to plan and implement IDDE programs. Getting the right information can require going beyond the minimum investigative approaches; planning, using technology, and leveraging experienced field teams can reduce long-term costs and enhance effectiveness in identifying and abating illicit discharges.

ABOUT THE AUTHOR

- Zach Henderson is a practice leader at Woodard & Curran with more than 20 years of experience in municipal stormwater and water resource programs. He focuses on planning, compliance, and stormwater asset management across New England. Mr. Henderson advocates for the clean water industry and sits on the National Municipal Stormwater Alliance Board of Directors, is active in WEF's Stormwater Institute, and works regionally with the New England Stormwater Collaborative and NEWEA and locally with the Maine Water Environment Association's Stormwater Committee.
- Garrett Bergey, director of field operations at SDE, Inc., is a certified professional in municipal stormwater management and has been in the environmental engineering industry for more than 10 years. He is an expert in the collection and delivery of data for field services for storm drainage and sanitary sewer infrastructure projects, including IDDE, inflow and infiltration investigations, and combined sewer separation projects. He has overseen the field work on over 30 IDDE projects, including Boston Water and Sewer Commission's city-wide illegals program.

Green infrastructure and climate change—a One Water approach

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ABSTRACT | Increasingly, green infrastructure approaches are becoming more widely accepted and implemented as strategies to mitigate the impacts of climate change. Depending on your perspective, green infrastructure solutions can mean a variety of different approaches. On a large scale, the creation or preservation of regional open spaces provides significant capacity to accept flood waters, reduce heat island impacts, offset carbon emissions, and restrict development in vulnerable areas. On a site scale, green stormwater infrastructure collects, treats, detains, and infiltrates stormwater at its point of generation, reducing downstream flooding and improving water quality. This paper provides a high-level analysis of both approaches. It describes specific green infrastructure best management practices as well as provides examples of cities where green infrastructure implementation is having a positive impact on climate change and water quality.

KEYWORDS | Green infrastructure, stormwater, climate change, gray infrastructure, adaptation, mitigation, landscape, best management practice

Over the last 20 years the term green infrastructure has taken on a range of meanings and different scales of application in planning and design practice. The Conservation Fund defined green infrastructure as "a strategically planned and managed network of wilderness, parks, greenways, conservation easements, and working lands with conservation value," typically at the regional scale (Benedict and McMahon, *Green Infrastructure: Linking Landscapes and Communities,* Island Press, 2006). More recently, EPA defined green infrastructure as "a stormwater management approach that mimics natural hydrologic processes," typically at local and site scales. Common to both definitions is the notion that green infrastructure provides environmental, economic, and social co-benefits.

Applications of green infrastructure—be they regional or site-specific—are becoming more widespread. At the same time, climate change concerns have become prominent in our lives, and green infrastructure has become an acknowledged climate change adaptation strategy. Organizations including the American Water Works Association and the American Planning Association's (APA's) Water and Planning Network call for planners and allied professionals to adopt an integrated approach to water resource management known as "One Water." This narrative describes the role that green infrastructure can play in helping our cities and regions address climate change impacts within the context of One Water. Although the focus is on adaptation, green infrastructure can also play a role in climate change mitigation (e.g., by sequestering carbon).

As the earth's temperature continues to rise, the impacts of climate change have become more apparent. Projections of these impacts are continually being developed and updated based on factors such as carbon emission scenarios, population, land use/land cover, and transportation patterns. The International Panel on Climate Change (IPCC), composed of scientists and climate change experts from industry and non-governmental organizations, has studied and reported on climate change causes, impacts, mitigation, and adaptation since 1990. The IPCC is updating its "Climate Change 2014: Synthesis Report" and is scheduled to next release a comprehensive report in 2022. The IPCC's most recent reports, "Special Report on Climate Change and the Land" (August 2019) and "Special Report on the Ocean and Cryosphere in a Changing Climate" (September 2019), are available at ipcc.ch/reports.

The Regional Green Infrastructure Framework developed for the Greater Baltimore Wilderness Coalition demonstrates how green infrastructure can be used as a climate change adaptation strategy at the regional scale

In addition to the IPCC reports, climate change studies and planning documents are being produced for cities throughout the world. American cities such as Boston, New York, and San Francisco, among others, are evaluating the long-term impacts of climate change and exploring ways to adapt and become more resilient to it. These impacts are difficult to quantify and depend largely on our ability to cut global carbon emissions. However, virtually all studies project significant impacts locally, for example increased flooding due to more intense storm events and (in coastal environments) sea level rise and storm surge.

Impacts such as increased flooding and more severe droughts will greatly affect water resources. Although drinking water, wastewater, and stormwater have traditionally been addressed in separate professional "silos," the interrelated nature of water resources is prompting planners and water professionals to think of water more holistically. Planners Advisory Service Report 588, *Planners and Water* (Cesanek, Elmer, and Graeff, APA 2017) describes One Water as the idea that "all water within a watershed is hydrologically interconnected and is most effectively and sustainably managed using an integrated approach." For example, the quality of stormwater runoff contributes to the overall water quality of rivers, streams, and wetland resources. These resources in turn affect the quality of water supplies. High rates of runoff generated by major storm events increase erosion and sedimentation, affecting the quality of water resources and therefore drinking water supplies, and increasing downstream flooding.

Traditional gray infrastructure collects and rapidly conveys stormwater downstream, typically with little or no treatment or detention, thus exacerbating downstream flooding. Older cities such as New York, Philadelphia, Boston, and Washington, D.C., have combined storm–sanitary sewer systems that include hydraulic relief in the form of combined sewer overflows (CSOs). During high rainfall events, sewers that normally carry combined sanitary sewage and stormwater to a treatment facility overflow into CSO relief outlets, and these discharges of mixed stormwater and untreated sanitary sewage result in quality degradation of the receiving rivers and streams. Even in cases where CSO water is stored and later pumped to the wastewater treatment facility, additional stresses are placed on that facility. The likelihood of combined sewer discharges of mixed sanitary and storm sewage increases as the intensity of storm events—exacerbated by climate change—increases.

New York City Department of Environmental Protection rain garden

Many water and wastewater treatment plants, which are considered critical infrastructure systems, have been built in low-lying areas near water supply sources and wastewater discharge outfalls. Facilities in or near floodplains or in coastal areas subject to sea level rise and storm surge are particularly vulnerable to higher-intensity storms exacerbated by climate change.

GREEN INFRASTRUCTURE AS A CLIMATE CHANGE ADAPTATION STRATEGY

While the concept of green infrastructure was developed independently of concerns about climate change impacts, it is finding widespread application as a climate change adaptation strategy across scales, from region to city, neighborhood, and site. Viewed as a regional open space network that conserves natural ecosystem values and benefits people, green infrastructure can build resilience to shocks (e.g., major flooding events) and stresses (e.g., rising temperatures) associated with climate change. For example, preservation of forested lands in a watershed's upper reaches increases groundwater recharge, thus improving the quality and quantity of drinking water supplies, and reduces runoff into rivers and streams that contributes to downstream flooding.

The Regional Green Infrastructure Framework developed for the Greater Baltimore Wilderness Coalition (GBWC) by a team led by The Conservation Fund, with the American Planning Association as co-principal investigator, demonstrates how green infrastructure can be used as a climate change adaptation strategy at the regional scale (planning.org/nationalcenters/green/gbwc). Prepared with the support of a Hurricane Sandy coastal resiliency grant administered by the National Fish and Wildlife Foundation, the framework identified five green infrastructure strategies to enhance community and regional resilience to coastal storms and climate change:

1. **Natural Resource Protection**: Preserve lands with valuable and vulnerable resources providing hazard mitigation and other co-benefits, including floodplains, wetlands, forest, stream systems, steep slopes, hydric and highly erodible soils, and important habitat areas.
2. **Urban Forest Enhancement and Restoration**: Maintain, enhance, and restore tree canopy in urban and suburban communities to reduce stormwater runoff, ameliorate the urban heat island effect, and improve air quality.
3. **Multi-benefit Green Stormwater Infrastructure**: Retrofit developed areas to reduce impervious surface and incorporate best management practices such as bioretention areas, green streets, and green roofs to reduce vulnerability to flooding.
4. **Critical Infrastructure Protection**: Use green infrastructure to reduce extreme weather risks to critical infrastructure, including key transportation corridors, power production and transmission facilities, hospitals, and emergency management centers.
5. **Coastal Defense**: Preserve/restore natural habitat and introduce nature-based practices (e.g., living shorelines) to protect against coastal flooding, storm surge, and sea level rise.

At the local or site scale, many cities are implementing green stormwater infrastructure as a climate adaptation strategy (equivalent to the GBWC's regional resilience strategy No. 3). New York City, Washington, D.C., Philadelphia, and Boston are working toward complying with EPA consent decrees that require a reduction in CSOs to nearby rivers and streams. Green stormwater infrastructure is integral to each city's strategy to reduce CSO discharges.

In New York City, for example, the New York City Department of Environmental Protection (NYC DEP) is constructing thousands of rain gardens/bioswales throughout the city. These installations collect stormwater close to where it is generated, treating it and infiltrating it into the ground before it can be discharged to the city's combined sewer system. Although the rain gardens do not eliminate stormwater discharge to combined sewers, particularly during larger rainfall events, they do reduce the amount and frequency of stormwater discharge and preserve capacity in the gray infrastructure system by removing the first 1 to 2 in. (2.5 to 5 cm) of rainfall. Most smaller storms (about 90 percent of all storms) can be handled by the rain gardens, thus reducing downstream discharges, flooding, and erosion and sedimentation impacts. Effectively, this city-wide network improves capacity in the gray infrastructure system to handle storms with increased intensity due to climate change. NYC DEP has spent $600 million on its green infrastructure program since 2012 and has committed $1 billion through 2029 to expand this system; Philadelphia and Washington, D.C., have invested similarly in meeting water quality goals.

Philadelphia has implemented its "Green City, Clean Waters" program to manage stormwater by building and maintaining public stormwater infrastructure and by regulating private development. Green City, Clean Waters calls for an investment of $2.4 billion over the next 25 years in public infrastructure. This program is increasing green stormwater infrastructure in Philadelphia, making it a significant part of the EPA mandated goal to reduce polluted stormwater overflows discharging into the creeks, streams, and rivers by 2035. By using green stormwater infrastructure, residents will not only see clean water improvements, but also other "triple bottom line" benefits, including more green spaces, reduced heat island effects, and more local jobs to maintain the sites.

Rain gardens are not the only site-specific green stormwater infrastructure strategy used to adapt to climate change impacts. Other strategies include bioretention basins, pervious paving systems (such as pavers, asphalt, and concrete pavement), rainwater harvesting cisterns, underground infiltration systems, and green roofs. These systems collect stormwater runoff at its point of generation, thus preserving downstream water quality and reducing erosion and sedimentation impacts. Installing different types of green stormwater infrastructure in sequence enhances water quality treatment and infiltration and reduces discharges to combined sewer systems or downstream water resources.

In addition to managing stormwater, site-scale green infrastructure mitigates the urban heat island effect by reducing impervious surfaces and increasing vegetative cover in developed areas. Studies have shown that nature-based solutions such as street trees in urban areas encourage activity along developed streetscapes, thus providing social benefits and stimulating economic development.

Green infrastructure solutions, both regionally and at sites, are increasingly part of our built and natural environments and important tools to help communities adapt to climate change. Past approaches to managing stormwater have considered urban stormwater runoff to be a waste product to be collected, conveyed, and discharged without treatment into natural systems. Collecting, treating, and infiltrating stormwater at its source using green infrastructure provides many environmental, social, and economic benefits. Green infrastructure has already arrived in many of our nation's older cities. Over time, as climate change impacts become more intense, we will see green infrastructure become an increasingly important adaptation strategy, as part of a One Water approach.

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Stormwater *management practices, initiatives, and regulations*

CREATION OF THE STORMWATER COMMITTEE

Over the past two decades, the focus on stormwater management practices, initiatives, and regulations within New England has increased, because stormwater has had a large impact on our water industries and society. As the clearinghouse for water quality information, education, and collaboration, NEWEA recognized this growing sector and how it impacts and correlates with the wastewater and drinking water quality goals set under the organization's mission. During NEWEA's 2011 Planning Session in Portland, Maine, facilitated by Matt Formica, a seed was planted to form an ad hoc Stormwater Committee.

Angela Blanchette (right), chair of NEWEA Stormwater Committee, and Kate Edwards, vice chair, at the Specialty Stormwater Conference in Portsmouth, New Hampshire, in 2018

The interest and initial success of this committee was largely due to Ginny Roach, who furnished the driving force that got it off the ground. As the first chair of the Stormwater Committee, Ginny led the charge to develop the committee's mission statement and bring together the most knowledgeable and experienced stormwater professionals in the industry to help shape the path forward. The committee identified awareness, education, and

During NEWEA's 2011 Planning Session a seed was planted to form an ad hoc Stormwater Committee

information sharing about this fast-growing and ever-changing industry as the greatest needs. In response to these needs, much of the 2011 CSO/Wet Weather Issues Specialty Conference was dedicated to stormwater-related issues. The need for still more information on the topic prompted a standalone Stormwater Seminar in 2012.

Since this initial event, the Stormwater Committee has hosted or partnered with another committee to host a specialty conference every other year, including this year's collaboration with the Watershed Management and Sustainability committees on a new virtual platform. These collaborations have been a highlight of the Stormwater Committee, weaving the thread of stormwater management throughout all aspects of the water industry. The pinnacle was the work of our committee to support the National Low Impact Development Conference, held in Portland, Maine, in 2016.

COMMITTEE MISSION

Through the hard work performed during this committee's formative years, we have shaped and grown our mission. The Committee has three goals:

1. Support communities and industries tasked with managing, treating, and mitigating the impacts of stormwater
2. Increase awareness of and ability to cope with stormwater management issues and legislation throughout New England
3. Review technical practices and disseminate stormwater management information to NEWEA membership

Implementation of these goals has led to many prominent collaborations across the NEWEA and WEF organizations.

MEMBERSHIP

As awareness of the importance of stormwater management in our region has grown, so has our membership. NEWEA's Stormwater Committee comprises 56 members. We are proud that our committee members represent all six New England states and include representatives from many sectors, including federal, state, and local government, consultants, and vendors. With the diverse expertise brought together to share ideas, concerns, and solutions, the committee has been fruitful for the region.

NEW ENGLAND STORMWATER COLLABORATIVE

NEWEA Stormwater Committee members have been asked to represent the group on region-wide initiatives, such as the New England Stormwater Collaborative working group, a partnership of organizations including American Public Works Association (APWA), New England Water Works Association (NEWWA), and NEWEA. This group aims to advance awareness, identify issues, and provide possible solutions to the common pitfalls of stormwater management throughout New England. The

by Angela Blanchette, PE, Stormwater Committee Chair

Golden Raindrop awardees—an elite group of stormwater professionals: (left to right) Dr. James (Jamie) Houle, Robert (Brutus) Cantoreggi, Kerry Reed, Virginia (Ginny) Roach, Zach Henderson, and Maria Rose (missing from photo: Doug McDonald)

The best ideas are those that originate outside the box and use New England ingenuity to deal with the stormwater issues we all face

New England Stormwater Collaborative annually requests submissions for its Stormy Awards, which recognize groups and individuals who advance stormwater management through simple and effective ways to boost funding, provide program efficiencies, or foster political support. The best ideas are those that originate outside the box and use New England ingenuity to deal with the stormwater issues we all face. Every year, the three Stormy Award-winning projects are highlighted at one of the organizations' annual conferences.

GOLDEN RAINDROP AWARD

In 2014 the Stormwater Committee established the Golden Raindrop Award to recognize NEWEA members who made the most significant contribution in the stormwater field. Nominees are voted by the Stormwater Committee members. The list of recipients is a recognizable who's who of the stormwater profession. This elite group includes Maria Rose, City of Newton; Doug McDonald, Town of Northampton; Virginia Roach, CDM Smith; Zach Henderson, Woodard & Curran; Brutus Cantoreggi, Town of Franklin; Dr. James (Jamie) Houle, University of New Hampshire; and Kerry Reed, City of Framingham.

NEXT CHAPTER TO BEGIN

As the stormwater industry evolves, so will this committee's mission. Based on Executive Committee support, including the input and encouragement from NEWEA's current president, Jennifer Kelly Lachmayr, the Stormwater Committee can expand and enable more specific initiatives to assist members with tools and resources to educate, provide outreach, and deliver compelling cases for investment in and support for our stormwater infrastructure and stormwater professionals.

NEBRA Highlights

National Biosolids Data Project is Getting Done

The National Biosolids Data Project (NBDP) is finally getting done, thanks to numerous contributions from around the country. NEBRA is leading this long-needed collection of data on biosolids management in the United States, officially called the "2nd National Biosolids Regulation, Quality, End Use, and Disposal Survey," in collaboration with Northwest Biosolids, the California Association of Sanitation Agencies (CASA), and BioCycle. NEBRA is coordinating with NEIWPCC, which is collecting and analyzing data for the New England states and New York.

NBDP Report cover

The first survey report by NEBRA and partners was published in 2007, compiling 2004 data on biosolids generated and managed across the country. These data remain the most comprehensive available and have been relied on and referenced by biosolids management professionals, engineering consultants, researchers, policy makers, regulators, and technology vendors nationwide. But they are outdated. For years, calls have been made for an update. Greg Kester, director of renewable resource programs for CASA, says, "We as a profession are weakened without data about what we do."

In 2019 through May 2020, with support from an EPA Region 4 cooperative agreement, the project team completed a literature review and methodology, including preparing the data-gathering tools for this second national biosolids survey. Preparations have included consultations with expert advisors (who are kindly continuing through the end of the project) and other stakeholders who rely on data: university researchers, market assessment and financing firms, technology developers, and policy decision-makers.

With adequate private funding secured, the data collection began in October, and the team hopes the analysis and draft report will be complete by the end of March 2021. As with the first national survey, the data and analysis will also be peer reviewed and published, and the project team will disseminate the findings through professional publications and conferences. The team will focus on data from 2018 (pre-PFAS and pre-COVID impacts). We are sure that a lot has changed since 2004, and we cannot wait to dig into the data.

This second survey will allow comparisons of the 2018 data with 2004 data to discern trends; however, the second survey will include additional data on biosolids economics and energy recovery. The importance of this work cannot be stressed enough. Tanja Rauch-Williams of Carollo Engineers, who led the WEF's water resource recovery report, said about the first national biosolids survey, "This is one of the most important database pieces for resource recovery tracking."

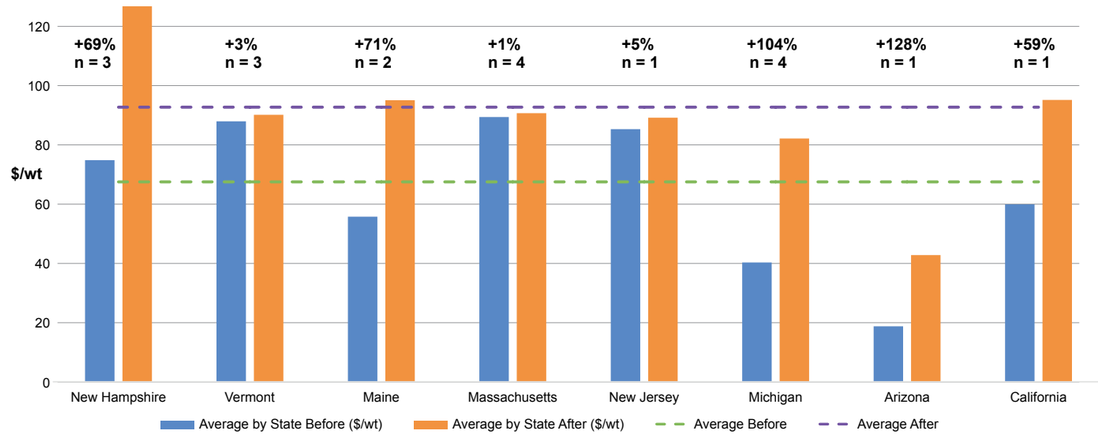
Major pledges in support of the NBDP included the National Association of Clean Water Agencies, WEF, Denali Water, Hazen and Sawyer, San Francisco Water Power Sewer, and the Milwaukee Metropolitan Sewerage District (home of Milorganite, a biosolids fertilizer). Thanks to all!

For more details about the project, go to nebiosolids.org/national-biosolids-survey-2018-data.

PFAS Cost Impacts Study Published

A new report, *Cost Analysis of the Impacts on Municipal Utilities and Biosolids Management to Address PFAS Contamination,* was published in late October. The report, by CDM Smith, summarizes the study commissioned in early June that was funded by WEF and the National Association of Clean Water Agencies in a project managed by NEBRA.

According to the report, the average costs for managing biosolids increased 37 percent in states with stringent PFAS regulations, mainly in the Northeast but also in other areas of the country where PFAS has been a big issue. The data come from detailed interviews with 29 entities that generate, manage, and use biosolids products. CDM Smith, which contributed significant in-kind services to the project and completed the report in about five months, found that the major impact was on beneficial use programs. The report noted little to no impact on programs relying on landfilling and incineration as primary management methods. The report contains nine case studies of water resource recovery facilities and businesses affected by PFAS.



Residuals management cost impact by state—a graph from the new report *Cost Analysis of the Impacts on Municipal Utilities and Biosolids Management to Address PFAS Contamination*

The report also contains a chapter reviewing PFAS removal and destruction technologies, mostly for drinking water. It describes five promising technologies for PFAS removal and destruction from biosolids and wastewater matrices including vitrification and plasma-assisted sludge oxidation. Also mentioned are four emerging technologies including foam fractionation. Analogies to actual costs for drinking water PFAS removal projects are provided to estimate the per gallon costs of constructing and operating the various new process technologies for wastewater.

EPA's Recent PFAS Research and Problem Formulation

In mid-October, EPA published a Request for Applications for biosolids research! EPA announced this new funding opportunity to identify, characterize, and manage risks of known and emerging chemical pollutants found in biosolids, with PFAS at the top of the list. EPA will be making nearly $6 million available to private non-profit institutions and public and private universities and colleges within the United States that can do this research. The deadline to apply is January 5, 2021. For more information, go to epa.gov/research-grants/national-priorities-evaluation-pollutants-biosolids.

EPA held a free webinar on October 29 addressing "Biosolids PFAS Research at the EPA." Presenters included Dr. Marc Mills and Ronald Herrmann of EPA's Office of Research and Development. The presentation covered the state of the science related to PFAS in biosolids as well as research needs and a biosolids land application field study. On November 12, EPA hosted a webinar, "Biosolids PFOA and PFOS Problem Formulation Meeting for Stakeholders," that NEBRA officers and many members attended.

EPA scheduled a National Biosolids Meeting to be held virtually December 8–10. This meeting aimed to bring together EPA, state and tribal representatives, academia, utilities, and other biosolids stakeholders to initiate a dialogue on the future of the national biosolids program. According to Liz Resek, EPA's biosolids lead in the Office of Science and Technology under the Office of Water at EPA headquarters, "It has been almost 10 years since EPA has brought co-regulators and biosolids stakeholders together. We are excited to be able to facilitate the exchange of technical and programmatic biosolids management successes and challenges, while helping to build and strengthen relationships and collaboration." NEBRA as well as numerous stakeholders from New England planned to participate in this meeting.

Lastly, EPA has updated its "PFAS Master List of PFAS Substances," now up to 9,252 chemicals. Check it out at comptox.epa.gov/dashboard/chemical_lists/PFASMASTER?s=09.

New WEF Biosolids Position Paper

On September 24, WEF published a new position paper on biosolids as adopted by the board of trustees. The official announcement said the following:

"WEF recognizes that biosolids, a natural byproduct of wastewater treatment, are a renewable resource that is too valuable to waste given our growing needs for renewable energy and sustainability. Thus, WEF endorses and encourages the innovative beneficial recycling and use of biosolids. This updated statement expands WEF's prior position that had focused primarily

on land application of biosolids in support of EPA regulations."

It also said that biosolids are a valuable resource that can and should be beneficially managed and used.

WEF's stated support includes the following:

- Continued regulation of biosolids under the Clean Water Act in the United States and similar regulations in other countries
- Consistent and science-based legislation and regulations that support the beneficial use of biosolids
- Safe use of biosolids in compliance with national, regional, and local regulations
- Land application of biosolids that returns valuable nutrients and carbon to soils
- Recovery of the energy in biosolids to generate renewable energy
- Adequate funding for the advancement and communication of research to further best practices and strengthen public trust in biosolids
- Promotion of biosolids as safe for public health, and the highest and best use of a beneficial byproduct of wastewater treatment

The full text of the September 24 biosolids management position statement is available at wef.org.

Read more and stay abreast of the latest biosolids/residuals developments at nebiosolids.org/news.

Tribute to Ned Beecher

Annual Membership Meeting Held via Zoom Included Tribute to Ned Beecher

NEBRA's annual membership meeting was held virtually via Zoom on October 15. The meeting included the usual agenda items at annual all-member meetings, including the annual financial report. Before starting his financial presentation (where it would become apparent that NEBRA's original executive director, Ned Beecher, is no longer a salaried NEBRA employee), outgoing Treasurer and Board Member Andrew Carpenter gave an extended tribute to Mr. Beecher and his impact on biosolids recycling, regionally as well as nationally. The thanks were conspicuous throughout the slideshow, including quotes from those who have come to know Mr. Beecher through biosolids as well as old photos of him and his accomplices throughout the years. Both the slides and the video clip can be found at nebiosolids.org/board-of-directors.

As part of the membership meeting, Executive Director Janine Burke-Wells reviewed accomplishments over the last year, including the continued focus on PFAS. She reported that NEBRA had responded to pleas from members in early 2020 for PFAS communication/outreach materials and a report about cost impacts. NEBRA delivered on both items in collaboration with NEWEA, WEF, the National Association of Clean Water Agencies, and similar associations. Ms. Burke-Wells mentioned the increased focus on NEBRA committees with new and energized committee leaders. President Tom Schwartz talked about initiatives for next year, including a review of the organization's strategic plan "to ensure a relevant and sustainable NEBRA" into the future.

The annual board of directors elections took place with current board members Cheri Cousens, Lise Leblanc, and Mark Young each expressing their willingness to accept another term. With Mr. Carpenter's director position to fill, Nominating Committee Chair Mark Young submitted the nomination of Eryka Reid of Resource Management, Inc., with whom he had previously worked on Lowell's Youth and the Environment Program. All four were elected to three-year terms. Mr. Schwartz of Woodard & Curran and Deb Mahoney of Brown & Caldwell were re-elected president and vice president of the board, respectively. Isaiah Lary of the Lewiston-Auburn Water Pollution Control Authority was re-elected secretary. As no one has volunteered fill the new treasurer vacancy, the board plans to fill that position as soon as possible.

For those interested in the budget report, you can find it on the NEBRA members-only page under the Finance Committee toward the bottom of the page.

Janine Burke-Wells, Executive Director
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For additional news or to subscribe to NEBRAMail, NEBRA's email newsletter, visit nebiosolids.org

nebra
North East Biosolids & Residuals Association

Highlights from the Virtual 2020 Northeast Residuals & Biosolids Conference

This year's annual Northeast Residuals & Biosolids Conference, co-hosted by NEBRA and the NEWEA Residuals Management Committee, was held in virtual sessions every Thursday afternoon in October. Despite a few technical glitches, the program was well attended and well received. The first session on October 1 kicked off the conference with presentations mainly related to—What else?—PFAS (perfluoroalkyl and polyfluoroalkyl substances).

The concern and interest in anything PFAS were reflected in the attendance at this session—nearly 100 water professionals participated, by far the highest attendance for any of the five virtual conference sessions. Included were a presentation entitled, "Cost Analysis of the Impacts on Municipal Utilities of Biosolids Management to Address PFAS Contamination" and another regarding the fate of PFAS in multiple hearth incinerators. There was also great interest in a report by Dr. Paula Mouser of the University of New Hampshire on her team's research into the fate of long chain and short chain PFAS compounds in wastewater treatment facilities. NEWEA and NEBRA are both planning to report on that research in upcoming publications.

The second session, on October 8, was all about resource recovery, with presentations covering effective co-digestion programs, energy generation at small-scale facilities, and optimization of two-stage anaerobic digestion via recycle for aerobic digesters. The third session focused on thermal processes, with presentations about thermal drying, pyrolysis, and co-digestion with thermal hydrolysis.

The ever-popular Regulators Roundtable was held on October 22. This year, the panel included regulators from every New England state, New York, and even Colorado. NEIWPCC organized the event, and the panelists were asked "What will society do with its residuals?" Not many comforting answers were provided (yet), but important discussions did occur about state regulatory efforts and how those impact biosolids management.

The last day of the conference, October 29, featured a virtual student poster contest organized by NEBRA's Research Committee that attracted eight outstanding young researchers. Thank you, Research Committee judges: Chair Tracy Chouinard, Andrew Carpenter, Ajay Singh, and Ned Beecher. The judges had a difficult job in choosing winners from among all the excellent student presentations. They did not come to a firm agreement until the next morning! The winners:

1st Place ($300 prize) Katherine Porterfield, PhD student, University of Vermont, Title: *Phosphorus Recovery and Reuse from Anaerobically Digested Dairy Manure*

2nd Place ($200 prize) Eric Walling, PhD student, Université Laval in Quebec, Canada, Title: *Optimizing Composting through Modelling*


Student poster contest winner Katherine Porterfield

3rd Place ($100 prize) Kennedy Brown, junior undergraduate at the University of Vermont. Title: *Elucidating the Potential of Agricultural Waste Management Systems to Reduce Greenhouse Gas Emissions in Vermont*

All the research projects had applicability to residuals/biosolids management and were well defended by the student contestants. We hope that attendees watching the event live learned a few things from these brilliant kids!

Thank you, sponsors of the student cash prizes: BioForceTech, Northern Tilth, Jeff McBurnie, Brown & Caldwell, and Lystek. Session poll responses showed great support for continuing to host student poster contests as well as finding funding for residuals and biosolids research projects. Based on the poll, research topics of most interest were improving the quality of compost and other agricultural soil amendments using biosolids, and nutrient recycling/recovery from wastewater.

As part of this year's virtual conference, NEWEA and NEBRA organized several virtual tours: the new biosolids dryer installation in Hookset, New Hampshire (hosted by Resource Management, Inc.) and the Woonsocket, Rhode Island thermal conversion facility (hosted by Synagro). The first three technical sessions included Technology Highlights, which featured various technological processes offered by several innovative firms.

Conference session sponsors included the following: Englobe; Hoyle, Tanner & Associates; Griffin Residuals, LLC and Gryphon Environmental, LLC; Vista Analytical Laboratories; and BioForceTech. A virtual exhibit hall hosted "booths" for David F. Sullivan & Associates, Resource Management, Inc., Vista Analytical Laboratories, NEWEA, and NEBRA. Scavenger hunts were held with prizes at each session. NEWEA and NEBRA even organized a virtual Happy Hour after the Regulators Roundtable that included a biosolids trivia contest and a game of "Two Truths and a Lie."

WEF Delegate Report

2020 was not the year we expected.

At this time last year, NEWEA's team of WEF delegates (at least three of us active at any one time) started planning attendance and participation at the four WEFMAX (WEF Member Association eXchange) conferences scheduled for the spring of 2020 in Charleston, South Carolina; Honolulu, Hawaii; Jersey City, New Jersey; and Fargo, North Dakota. In coordination with the other delegates and NEWEA leaders, each delegate selected at least one conference to attend and began to register, plan travel, and prepare.

Then COVID-19 hit and changed everything. Well, not quite everything; it changed a lot but not our resilience—or our enthusiasm—or our energy and interest in this industry that is critical to the well-being and continuity of our civilization.

Along with so many others, we retooled, reset our approach, and reshaped the "new normal." Conferences, including WEFMAX and WEFTEC, became virtual, and technology was leveraged to the hilt to achieve the necessary exchange of information across all the WEF member associations (MAs).

The WEF House of Delegates (HOD) meeting at WEFTEC was virtual this year, and we still worked through a full agenda as in every other year, with active participation from our delegates.

So, read on for input from each delegate describing their activities, observations, and takeaways from this demanding year—a year that has challenged us all to be at our best.

Peter Garvey, NEWEA Delegate

2020 has been my first year representing NEWEA as a WEF delegate, and I am honored to have been selected.

The excitement was building at this time last year, as planning got underway for the four WEFMAX conferences. I signed up for the events in South Carolina and New Jersey—and was excited at the prospect of meeting delegates from across the nation. As we know, the conferences became virtual, but I still participated on behalf of NEWEA. Mary Barry and I presented to virtual WEFMAX No. 2 in May. The topics we presented focused on NEWEA's Charitable Giving task force, NEWEA's merger with the Northeast Water Innovation Network (NEWIN), and the Water Warriors jobs initiative.

I also participated in the WEFTEC Connect HOD program in October, which incorporated various activities. For me, the standout out activity was the diversity and inclusion Empathy Mapping exercise in which I participated on HOD Sunday. I was not familiar with this type of exercise—in short, it uses a strategic framework to help one person "walk in the shoes" of another person with certain characteristics (physical limitations, gender and racial identities, sexual orientation, among others) while participating in industry activities (NEWEA, WEF, or other) and how others' experiences can differ from our own. The exercise opened my eyes to things I (and maybe others) take for granted.

I will conclude by saying thank you to Jim Barsanti, the other NEWEA delegates, and the NEWEA team for coaching and supporting me as I navigated my first year as a delegate.

Sue Guswa, NEWEA Delegate

Resilience is at the core of our water quality profession. In 2020 resiliency became part of every aspect of our personal and professional lives.

As chair of the HOD Public Education work group, I led a group of more than 30 delegates to promote the *Brave Blue World* documentary and facilitate at least one public screening of the movie through each MA. *Brave Blue World* paints an optimistic picture of how humanity is adopting new technologies and innovations for a sustainable water future. WEF produced this film together with industry leaders and innovators. It comes with a bonus: Matt Damon is a production partner and is in the film, and Liam Neeson is the narrator.

The film premiered in Los Angeles in December 2019, and we worked through the early winter to schedule screenings and develop guidance and content to facilitate the screening logistics and related programming. NEWEA held the first MA screening of the documentary at the joint NEWEA/NEWWA YP Summit in January 2020 during our Annual Conference. This was also one of the last in-person screenings because not long after, we were all staggered by the Coronavirus pandemic.

Impressively, the production company and WEF were resilient and pivoted to on-line screenings in the spring. We retooled the supporting materials and continued with virtual screenings throughout the summer and fall. Finally, WEF was thrilled to announce that the *Brave Blue World* documentary was released on Netflix on October 21, coinciding with Imagine A Day Without Water. Please check it out if you have not yet seen it.

I also had the privilege of serving on the HOD Nominating Committee that reviews applications for HOD committees and leadership positions. It was awesome to see all the delegates from NEWEA selected for HOD committees. This shows NEWEA's tremendous reputation of having impactful delegates. Additionally, Matt Formica, our third-year delegate, was selected to be a delegate at-large, so this year WEF will have five delegates from NEWEA! Congratulations, Matt!

Currently I am on the HOD Steering Committee that reviews and prioritizes information from HOD committees and work groups and advises HOD leadership. As a member of the Steering Committee, I can help steer the direction of WEF in alignment with the priorities of NEWEA. I will also serve on the HOD Diversity, Equity, and Inclusion work group and the HOD Federal Advocacy work group, which will be chaired by (our own) Delegate at-Large Susan Sullivan.

2020 has been trying, but I am proud to be part of our resilient water industry. I am grateful that WEF and NEWEA have retooled and continued to support water quality education and outreach. And I am especially thankful for all the resilient operators who continue to provide clean water, uninterrupted, for our communities despite the challenges of these unprecedented times.

James Barsanti, NEWEA Delegate

As the curtain closed on my first year as a WEF delegate, I realized how fortunate I was to be involved in several initiatives that will provide value to our NEWEA membership. I was the chair of the HOD Outreach Committee responsible for creating awareness of HOD activities and work products within the HOD at-large and to MA leadership. This includes providing resources and training to WEF delegates and MA leaders and ensuring WEF work products are available on the WEF website and WEFCOM (WEF's business and volunteer communications platform). Our committee completed a flow chart that depicts the various activities a WEF delegate participates in, including various WEFTEC meetings and functions, WEF standing committees and work groups, and communication of these activities to the MA. We also prepared a WEF "avenues for involvement" presentation that connects the activities available to a delegate with WEF's strategic goals. For example, a delegate who wants to develop an engaged membership may participate in the Diversity, Equity, and Inclusion task force or in school outreach events, such as Waterpalooza or the student poster contest. Each of these work products and events is anticipated to be used by both WEF and MAs to recruit and train delegates, and we anticipate and hope they will be available in person again in 2021.

I participated on the Water Utility Workforce of the Future work group. Our work group conducted more than 30 interviews with operators across the country to learn about their training and recruiting practices and programs. The interviews have been compiled and submitted to WEF leadership for review. My activities for this year will include participating on the WEFTEC Advisory Committee and the Conference Resources work group. Given the uncertainty of COVID-19, we anticipate our conferences and seminars will continue to be remote, and I am looking forward to working with my WEF colleagues to make these events beneficial and informative. Finally, I will continue my work on two WEF technical committees. I am a member of the WEF Collection Systems Committee and will be project manager for the Operation and Maintenance Technical Practice group. I am also a member of the WEF Public Communication and Outreach Committee (PCOC) and will continue with the PCOC Awards subcommittee. I am looking forward to another productive and enjoyable year serving NEWEA as a WEF delegate!

Matt Formica, Delegate at-Large

I cannot believe I have served as one of NEWEA's three official delegates for the last three years. It would be an understatement to say things have changed locally, nationally, and globally during that time. However, one thing that has not changed is NEWEA's, WEF's, and the industry's passion and professionalism in providing clean water services that benefit the environment, the economy, and public health. I was pleased and fortunate to advocate for NEWEA and WEF over that time in many roles. These roles included HOD work group member each year, HOD Nominating Committee member and chair, two-year WEF Nominating subcommittee member (charged with selecting WEF's new yearly slate of officers), and HOD Steering Committee member this year. As noted above by Ms. Guswa, I was recently selected for another three-year term, this time as a WEF delegate at-large. This year will allow me to serve on the HOD Outreach Committee as well as the Diversity, Equity, and Inclusion work group. I look forward to both assignments and bringing experience and results back as suggestions to improve NEWEA. I have been fortunate to have participated with other NEWEA WEF delegates, and I look forward to continuing to do so in my new at-large role, on several issues critical to our industry: professional

development, student outreach, and public awareness, to name a few. I wish all the delegates the best as they look forward to serving and representing NEWEA over the next year and years to come.

Susan Sullivan, Delegate at-Large

WEFTEC did not go quite as we had expected, but the WEF staff and committee leadership worked remarkably hard to ensure that the virtual WEFTEC Connect did go on. For my part, WEFTEC 2020 ended my term as a committee leadership council (CLC) director. The CLC comprises chairs and vice chairs of all WEF committees and councils and all directors of the communities of practice (CoP).

The CLC was created by the board of trustees for WEF committees to share ideas, improve communications within WEF, and serve as a communication link between the committees and the board. For the past two years, I was the CoP director for leadership development and recognition. This group included the Student and Young Professionals Committee, Awards and Recognition Committee, Program Committee, and Manufacturing, Equipment, and Representative Committee. They were marvelous to work with as we all had to pivot to overcome COVID-19 and navigate the switch to virtual programming. I encourage all of you to consider applying as a CoP director at WEF. You will totally enjoy it.

In 2020 I also completed my first year as the WEF Government Affairs Committee vice chair. Recent accomplishments of that group include the following:

- Comprehensive report to modernize community financial capability and household affordability leading to a proposed 2020 Guidance by EPA in the Federal Register now on its way to finalization
- Congressional passage and establishment of a Stormwater Infrastructure Financing task force
- Completion of the first MS4 Needs Survey, which found an annual funding needs shortfall of $7.5 billion nationally and became the basis for the new American Society of Civil Engineers stormwater scorecard
- Congressional passage and establishment of the Sewer Overflow Control Grants program, which will provide new federal grants for combined sewer overflow, sanitary sewer overflow, and stormwater collection and conveyance infrastructure
- Congressional introduction of HR 3521, the Wastewater Infrastructure Workforce Investment Act, by Rep. Greg Stanton, which will provide up to $140 million over five years in wastewater workforce development grants
- A successful National Water Policy Fly-in and continued growth in attendance

Upcoming Government Affairs Committee activities include the following:

- Planning the annual forum, fly-in now set (perhaps virtually) for late April 2021 in Washington, D.C.
- Partnering with National Association of Clean Water Agencies, Water Research Foundation, WateReuse Association, and others to bring members and stakeholders together to advocate before Congress and federal agencies to increase funding for infrastructure investments
- Supporting passage of Water Resources Development Act 2020, tracking hearings and debates, and reaching out to congressional staff as well as encouraging MAs and members to reach out as well
- Reviewing and submitting comments on the recodification of the WOTUS (waters of the United States) rule and subsequent Federal Register notices
- Educating membership on administrative activities of the President of the United States

If any of these activities are up your alley, I encourage you to reach out to WEF and join the Government Affairs Committee.

2021 marks my final year as a WEF delegate at-large. For this year, I have joined the WEF Nominating Committee and agreed to be chair of the WEF Federal Advisory work group; this will amplify WEF's federal advocacy work with our MAs. The objective is to advance WEF's national policy issues with MAs and at the ground level. WEF can be even more impactful in Washington, D.C., with Congress if MAs work with their home staffs and educate members about our advocacy.

Annual Conference & Exhibit Preview

Virtual • January 26 & 28, February 2 & 4, 2021

NEWEA's premier water quality technical conference and exhibit will be taking place entirely virtually for the first time in 2021. Attendees, sponsors, speakers, and exhibitors will have the opportunity to network with their water quality colleagues; attend technical sessions on the latest practices, technologies, solutions, and regulations in the water quality industry; listen to students presenting on their research; connect with exhibitors; and earn credits for operator and engineering recertification—all without the time and expense required to travel to an in-person event. Our interactive platform allows for live Q&A; networking via one-on-one chat, video calls, and breakout rooms; on-demand and live technical sessions; and much more.

Each of the four conference days, taking place over the course of two weeks, will feature concurrent technical sessions, networking, and the exhibit hall. Additionally, in recognition of this year's theme "Advocate. Act. Be the Change.", as well as in preview of our forthcoming 2021 theme, we will be hosting panels addressing diversity, equity, and inclusion within the water industry.

Conference day one on January 26 will kick off with a keynote from Vikki Spruill, New England Aquarium President and CEO, and will conclude with the Student Poster Competition, featuring undergraduate and graduate students presenting on their water quality research. **Day two on January 28** will feature a panel on Diversity, Equity, and Inclusion. Also happening as part of week one, our Innovation Council will be holding a virtual Innovation Pavilion on Wednesday, January 27 from Noon – 2:30.

Conference day three, taking place February 2, will begin with another keynote on communicating the technical nature of water quality work to necessary audiences, namely community residents and elected officials. Day three concludes with the Women in Water Panel. The second Innovation Pavilion session will take place again from Noon – 2:30 on February 3. Our **fourth conference day on February 4** will conclude with our final technical sessions, exhibits, and the passing of the gavel to 2021 NEWEA President Virgil Lloyd.

We hope you will join us for our first-ever virtual conference. Although we can't be together in person, we look forward to presenting the latest water quality information and connecting with old acquaintances and new!

Conference Events*

Tuesday, January 26
Exhibit Hall ..... 11:00 AM (Opens)
Opening Keynote ..... 11:30 AM – 12:00 PM
Sessions 1 – 4 ..... 12:15 – 2:15 PM
Student Poster Competition ..... 2:30 – 3:30 PM

Wednesday, January 27
Innovation Pavilion
Opening Remarks ..... Noon – 12:10 PM
Panel Session ..... 12:10 – 12:40 PM
Panel Session ..... 12:45 – 1:15 PM
Student Shark Tank ..... 1:25 – 2:15 PM

Thursday, January 28
Exhibit Hall ..... 11:00 AM (Opens)
Opening Keynote ..... 11:30 AM – 12:00 PM
Sessions 5–8 ..... 12:15 – 2:15 PM
Diversity, Equity, & Inclusion Forum ..... 2:30 – 4:00 PM

Tuesday, February 2
Exhibit Hall ..... 11:00 AM (Opens)
Opening Keynote ..... 11:30 AM – 12:00 PM
Sessions 9–12 ..... 12:15 – 2:15 PM
Women in Water Forum ..... 2:30 – 4:00 PM

Wednesday, February 3
Innovation Pavilion
Opening Remarks ..... Noon – 12:10 PM
Panel Session ..... 12:10 – 12:40 PM
Panel Session ..... 12:45 – 1:15 PM
Panel Session ..... 1:30 – 2:00 PM

Thursday, February 4
Exhibit Hall ..... 11:00 AM (Opens)
Sessions 13-16 ..... 11:15 AM – 1:15 PM
Closing Remarks/Passing of the Gavel ..... 1:30 – 2:00 PM

*Times are subject to change

2021 Award Recipients

NEWEA Awards

Alfred E. Peloquin, CT ..... Gary Zrelak
Alfred E. Peloquin, ME ..... Mac Richardson
Alfred E. Peloquin, MA ..... Keith Bourassa
Alfred E. Peloquin, NH ..... Ray Gordon
Alfred E. Peloquin, RI ..... Stephen Buckley
Alfred E. Peloquin, VT ..... Margaret Dwyer
Operator, CT ..... Mark Bukowski
Operator, ME ..... Scott Lausier
Operator, MA ..... Carl Thurston
Operator, NH ..... Ray McNeil
Operator, RI ..... Jose Da Silva
Operator, VT ..... Marty Frizzell
Operator Safety Award ..... Shannon Eyler
Youth Educator Award ..... Kerry Reed
Paul Keough Award ..... Bonnie Combs
Elizabeth Cutone Executive Leadership ..... John Sullivan
Young Professional Award ..... Kate Roosa
James J. Courchaine Collection Systems Award ..... Don Kennedy
Founders Award ..... Jeanette Brown
E. Sherman Chase Award ..... John Esler
Clair N. Sawyer Award ..... Nora Lough
Biosolids Management Award ..... Hawk Ridge Compost
Committee Service Award ..... Kate Biedron
Wastewater Utility Award ..... Montville (CT) WPCA
Asset Management Excellence Award ..... John Vogl
Energy Management Achievement Award ..... Greater Lawrence (MA) Sanitation District

NEWEA Recognition (Stockholm Junior Water Prize)

CT ..... Colin Speaker
ME ..... Amara Ifeji
NH ..... Shreya Nagri

WEF

WEF Fellow ..... Charles Tyler

Student Design Competition/Water Environment
2nd Place ..... Samantha Kinnaly, Kate Engler, Annie Lamonte, Emma Totsubo (Northeastern University)

Student Design Competition/Wastewater
2nd Place ..... Ian Kosnik, Jake Senecal, Olivia Nachbauer, Sam Mikell (University of Vermont)

Operations Challenge—Division II
3rd Place Overall ..... Force Maine

WEF–MA Awards

Laboratory Analyst Excellence Award ..... Andy Wendell
William D. Hatfield Award ..... Jeff Gamelli
Arthur Sydney Bedell Award ..... Dennis Palumbo

Specialty Conference, Workshop, & Webinars

INFORMATION TECHNOLOGY & ASSET MANAGEMENT FAIR
Technology in the Water Works Industry

November 4 – 5, 2020

NEWEA's Asset Management Committee together with New England Water Works Association's (NEWWA) Information Technology Committee hosted two virtual sessions. The workshop had 40 participants.

TECHNICAL PRESENTATIONS
Wednesday, November 4

Remote Pressure Monitoring Using Fire Hydrants: A Case Study in How to Use Intelligent Hydrants to Respond More Effectively to Hydraulic Events
- Brett Johnson, Clow Valve Co., Rochester, NH
- Tom Bohrer, Nighthawk iHydrant, Coppell, TX

Gaining Essential Data From A Water Distribution System
- Nick Bates, E.J. Prescott, Gardiner, ME

Supplementing GIS Systems with Drone Technology in the Campus Environment
- Andrew Street, CivilView, Inc.
- Chelsea Bierkan, Woodard & Curran, Providence, RI

Leveraging Utility Data to Visualize, Analyze, and Optimize Wastewater Practices
- Michael Hanley, Dewberry, Boston, MA

Thursday, November 5

Global Pandemics and Natural Disasters Have Brought Incident Response Management Systems (IRMS) Into Perspective for Many Communities
- Alex Tabb, Daupler, Inc., Kansas City, MO

From Paper to the Cloud—Fall River Community Utilities
- Paul Ferland, Fall River Community Utilities,
- Jorge Garcia, City of Fall River, MA

Failure Is Not an Option—How Asset Management Defines Reliability
- William Hollman, New England Fertilizer Company, Quincy, MA

Not Your Average Computerized Maintenance Management System—Expanding the Benefits for the City of Portsmouth, NH
- Gisele Trivino, AECOM Water, Chelmsford, MA
- Peter Conroy, Peirce Island WWTF, City of Portsmouth, NH

CSO WEBINAR: **DIVING INTO PUBLIC NOTIFICATION OF CSO ACTIVATION**
June 24, 2020

NEWEA's Combined Sewer Overflow (CSO) Committee held a webinar on public notifications of CSO activation that included current and proposed requirements in New England and nationally along with potential liabilities and public perception.

Panelists:
- Fred Andes, Esq. Partner, Barnes & Thornburg LLP, Chicago, IL
- Joshua Schimmel, Executive Director, Springfield Water and Sewer Commission, Agawam, MA
- Thomas Sgroi, P.E., Director of Engineering, Greater New Haven WPCA, New Haven, CT
- Dan Vicari, P.E., Executive Director, Gary Sanitary District, Gary, IN

WATERSHED WEBINAR: **CHALLENGES FROM COASTAL SHORELINE RETREAT—PLANNING FOR NOW AND THE FUTURE**
August 5, 2020

NEWEA's Watershed Management Committee held a webinar on resiliency planning for coastal shorelines. The webinar included two presentations.

The first presentation was by Wade Burcham, PE, principal water resources engineer, Geosyntec, and discussed the Dauphin Island Causeway resiliency project and restoration of three miles (5 km) of living shoreline and nearly 100 acres (40 ha) of marsh habitat.

The second presentation was by Brian Caufield, PE, coastal systems resilience discipline lead, CDM Smith, who presented an overview of future resiliency projects, assessment of future risk, Technical Mapping Advisory Council (TMAC) recommendations, and Federal Emergency Management Agency (FEMA) Region I pilot study.

CEC WEBINAR SERIES
NEWEA's Contaminants of Emerging Concern (CEC) Committee held a series of one-hour webinars about CECs:

WEBINAR 1: **CEC 101—WHAT ARE THEY?**
Thursday, July 30, 2020
- Presenter: John Ross, PE, Brown and Caldwell, Andover, MA

Webinar 2: **CECs—Where are we now? Current State of Regulations and Research**
Thursday, August 27, 2020
- Presenter: Amy Hunter, PhD Candidate, Civil and Environmental Engineering Environmental and Water Resources Engineering Group, Tufts University

Webinar 3: **Addressing CECs with innovation technologies**
Thursday, September 24, 2020

Panelists:
- Julie Bliss Mullin, Aclarity Water
- Kobe Nager, 374Water
- Daniel Cho, Onvector
- Valentino Villa, Bioforcetech

Webinar 4: **Cost impacts and considerations for innovative CEC removal technologies**
Thursday, October 29, 2020
Presenters:
- Natalie Sierra, Brown & Caldwell
- Denise Funk, Brown & Caldwell

Moderator: Janine Burke-Wells, NEBRA

Webinar 5: **Communicating with stakeholders about CECs**
Thursday, November 12, 2020
Presenters:
- Melissa Harclerode, CDM Smith
- Vonnie Reis, City of Framingham, MA
- Jordan Gosselin, NEWEA communications coordinator

Moderator: Janine Burke-Wells, NEBRA

CLEAN WATER WEBINAR SERIES
An Innovative Approach to Brewery Wastewater Treatment
September 16, 2020

NEWEA held a one-hour webinar together with NEWEA's Gold Sponsor, Weston & Sampson
- Presenter: Michael (Smitty) Smith, PE

Moderator: David Elmer, PE, vice president and wastewater discipline leader, Weston & Sampson.

COLLECTION SYSTEMS CONFERENCE
September 10, 2020

NEWEA's Collection Systems Committee held its first virtual specialty conference and exhibit. Seventy-six meeting registrants participated online.

The technical presentations commenced on Thursday, September 10, 2020, with NEWEA President Jennifer Kelly Lachmayr and NEWEA Collection Systems Committee Chair Scott Lander providing the Welcome and Opening Remarks to attendees.

TECHNICAL PRESENTATIONS
Morning Session
ANALYZE THIS—Prioritization and Cost Savings During Challenging Times
Moderator: Kara Johnston, CDM Smith

Utility-Wide Data Analytics for O&M and CIP Prioritization of Sewer Systems
- Dr. Sergio Coelho, Baseform, Inc.

A Visual Representation of a Utility Master Plan in Gloucester, MA
- Eric Lemoi, Wright-Pierce
- Laurie Perkins, Wright-Pierce

Overcoming COVID-19 Challenges of Limited Staff & Guarding Against SSOs—Pipe Analysis Reduces Cleaning Schedule in San Diego, CA
- Jay Boyd, ADS Environmental Services

Managing Flows with Mixed Size Pump Selections in Trumbull, CT
- Allison Zeoli, Arcadis

Afternoon Session
FIX THAT—Innovative Approaches to Formidable Challenges in Upgrading Infrastructure
Moderator: Tom Loto, AECOM

Pipe Jacking vs. Microtunneling—A Story of Crossing the Connecticut River and Poor Ground Conditions
- Gus O'Leary, Kleinfelder

CSO Mitigation, Wet Weather Flows, and Regulatory Compliance—A Look into Fitchburg's Collection System Rehabilitation Plan
- Pat Cotton, Matt Houghton, Weston & Sampson
- Anthony (Tony) Maressa, City of Fitchburg

Unintended Consequences of Sewer Separation in Portland, ME
- Brendan Robertson, Portland DPW
- Gerald Remsen, Portland DPW
- Ron Kelton, Portland DPW

River Avenue Force Main—A Successful Emergency Rehabilitation and Partnership in Norwich, CT
- Bryan Manter, Jacobs
- Larry Sullivan, Norwich Public Utilities

Exhibitors:
Flow Assessment Services, LLC
Green Mountain Pipeline Services
Hazen and Sawyer
JWB Company/Hach Flow Group
Shea Concrete Products
Tata & Howard Inc
Vieux & Associates, Inc.
Williamson Pump & Motor

Sponsors
ADS Environmental Services
AECOM
Aqua Solutions, Inc.
Arcadis
Carlsen Systems
CDM Smith
Dewberry
Duke's Root Control, Inc.
Environmental Partners Group
EST Associates, Inc.
Flow Assessment Services, LLC
GHD, Inc.
Green Mountain Pipeline Services
Hayes Pump, Inc.
Hazen and Sawyer
Hoyle, Tanner & Associates
Jacobs
Kleinfelder
Mott MacDonald
Stacey DePasquale Engineering
Stantec
Surpass Chemical
Synagro Northeast, LLC
The MAHER Corporation
Tighe & Bond
Weston & Sampson
Woodard & Curran
Wright-Pierce

New Members September – November 2020

Raymond McNeil
Rollinsford, NH Water and Sewer District
Rollinsford, NH (PRO)

Evelyn Grainger
AECOM
Lowell, MA (STU)

Heather Low
Coventry, RI (STU)

Justin Stone
Plainville, CT (STU)

Robert Terlikowski
South Windsor, CT (STU)

John Price
Kennebunk Sewer District
Kennebunk, ME (PRO)

Casey Cammann
Heartland Water Technology
Andover, MA (PRO)

David White
Woodard & Curran
Providence, RI (PRO)

Ty R Morin
Kennebunk Sewer District
Kennebunk, ME (PWO)

Freddy Kade
Eosi
Bourne, MA (PRO)

John O'Keefe
Massa Products Corp.
Hingham, MA (PRO)

Geoff Davidson
Hingham, MA (PRO)

Alan Levy
Arcadis
Middletown, CT (PRO)

Earl Jones
Hudson, MA (PRO)

Dennis Tulimieri
Tulimieri Associates Inc
Glastonbury, CT (PRO)

Dan Boissonneault
Kennebunk Sewer District
Kennebunk, ME (PWO)

Academic (ACAD)
Affiliate (AFF)
Complimentary (COMP)
Corporate (COR)
Dual (DUAL)
Executive (EXEC)
Honorary (HON)
Life (LIFE)
Public Official (POFF)
Professional (PRO)
Professional WW/OPS (PWO)
Student (STU)
Young Professional (YP)

2021 NEWEA Executive Committee*

*Proposed 2021 NEWEA Executive Committee—pending the election vote at the annual business meeting of the membership on January 20, 2021

PRESIDENT
Virgil J. Lloyd
Manchester, CT

PRESIDENT-ELECT
Frederick J. McNeill
Manchester, NH

VICE PRESIDENT
Robert K. Fischer
South Burlington, VT

TREASURER
Clayton "Mac" Richardson
Windham, ME

PAST PRESIDENT
Jennifer Kelly Lachmayr
Wakefield, MA

EXECUTIVE DIRECTOR
Mary Barry

DIRECTORS—COUNCIL
Collection Systems and Water Resources
Vonnie Reis
Framingham, MA

Communications
Deborah S. Mahoney
Andover, MA

Innovation
Dr. Marianne Langridge
West Hartford, CT

Meeting Management
Amy Anderson George
Wakefield, MA

Management Review
Jennifer Kelly Lachmayr
Wakefield, MA

Public Outreach
Colin O'Brien
Andover, MA

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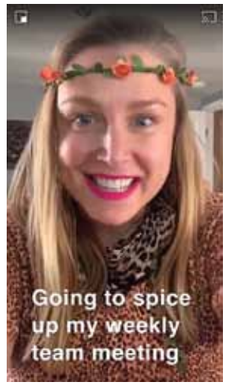
Remembering Kate Biedron

With a genuine and endearing smile that hit you from across a crowded room, Kate Biedron was someone you could never forget once you had met her. Kate was always the first to ask how you were doing, crack a joke to lighten the mood, or extend her hand to help someone. Kate made great things happen, most often just by being herself and bringing out the best in others. Tragically, Kate died from a car accident in April 2020. While her funeral on April 29 was restricted to close family and life-long friends due to the COVID-19 pandemic, the funeral procession route was literally lined with thousands of friends and colleagues standing in solidarity to demonstrate their love for her and support for her loved ones.

Kate earned universal respect and admiration from her peers, clients, and colleagues. She was a strong proponent of STEM and females in the wastewater industry, and she proudly nicknamed herself "sewer girl." Kate graduated from UMass Amherst with a Bachelor of Science in Civil and Environmental Engineering in 2005 and joined CDM Smith as a wastewater engineer. She took on progressively more professional responsibility and earned her master's degree in 2012 from UMass Lowell. Kate flourished at CDM Smith over her 15-year career and had recently been promoted to regional team leader, managing and mentoring staff throughout several New England offices. Colleagues and friends remember her as a fun, energetic, and a hard-working woman, who despite her successes never took herself too seriously. Several of her co-workers remembered one of the first team meetings she held after her promotion. She came to the meeting fully dressed up as the Tiger King's antagonist Carole Baskin. It was her way of putting the people she supervised at ease. "It was so typical of her," a co-worker remembered. "She never put on airs or worried about making fun of herself."



Kate doing her best to entertain colleagues at the start of the work-from-home era by running a team meeting as Carole Baskin

Kate also served in several positions with NEWEA, most recently as the Meeting Management Council director. She was also a strong advocate and promoter of the Young Professionals Summit at the NEWEA Annual Conference. Many people remember both Kate's dedication and good humor when she attended the Annual Conference with an ankle injury and cheerfully rode around on a scooter that did not slow her down one bit! Another NEWEA Annual Conference memory was during an event at a local Boston watering hole, when the wait staff could not keep up with the large crowd—naturally, Kate and a co-worker stepped up to help bus tables and take orders! This epitomized Kate; her natural instincts to help and intrinsic work ethic radiated from Kate. Many would agree with the way lifelong friend Sarah Pratt summed up Kate's approach to life: "Kick butt at everything!"

Kick butt at everything!

Her dedication to NEWEA was typical of how she reached out and volunteered to other groups. She was well known at CDM Smith for mentoring junior staff, including a young engineer from the Bangalore, India office. Both of her alma maters were grateful for her service on their alumni boards, and she contributed to her local community with years of service on the Lowell Conservation Commission. Also dear to her heart was a charity race that she organized in memory of her late cousin in Pelham, New Hampshire over the past four years.

Kate was constantly on the go, and she enjoyed traveling, bike riding, spending time with friends, visiting the beach, and especially being with her family. She adored her nephew Mason and the role of "Auntie Kate." She even organized a group of loved ones to cheer on her sister as she arrived at the hospital for the birth of Kate's niece (and namesake Maisie Kate!), who was welcomed just the day before her accident. We all lost a great friend on April 23 and she will never be forgotten.

In May 2020, NEWEA President Jenn Lachmayr authorized establishment of a task force to "honor the memory of Kate Biedron, an active NEWEA member, industry leader, professional engineer, mentor, and friend." To keep Kate's legacy moving forward, the NEWEA task force has developed a memorial fund in her honor, including supporting youth involvement in STEM through the purchase of a hands-on interactive water cycle model for the Dracut school system, development of an academic scholarship, and improvement in workforce opportunities for the water sector.

Visit the Kate Biedron Memorial Fund page (newea.org/kate-biedron-memorial-fund) to learn more and make a donation today.

Upcoming Meetings & Events

NEWEA INNOVATION COUNCIL REVERSE PITCH: WORKFORCE DEVELOPMENT (WEBINAR)
January 19, 2021

NEWEA ANNUAL CONFERENCE & EXHIBIT (VIRTUAL)
January 26 & 28, February 2 & 4, 2021

NATIONAL WATER WEEK & DC FLY-IN
April 25 – May 1, 2021
Washington, DC

NEWEA JOINT ENERGY & PLANT OPERATIONS SPECIALTY CONFERENCE
May 10 – 11, 2021
North Essex Community College, Haverhill, MA

AFFILIATED STATE ASSOCIATIONS AND OTHER EVENTS

MEWEA LEGISLATIVE EVENT (VIRTUAL) PART OF MWUA CONFERNECE
February 2, 2021

MWUA 95TH ANNUAL CONFERENCE & TRADE SHOW (VIRTUAL)
February 3 – 4, 2021

Measurement unit conversions and (abbreviations) used in the *Journal*

U.S.	International System of Units (SI)	U.S.	International System of Units (SI)
Liquid volume		**Length**	
gallon (gal)	liter (L)	inches (in.)	centimeters (cm)
cubic feet (ft^3)	cubic meters (m^3)	feet (ft)	meters (m)
cubic yards (yd^3)	cubic meters (m^3)	miles (mi)	kilometers (km)
acre-feet (ac ft)	cubic meters (m^3)	**Area**	
Flow		square feet (ft^2) or yards (yd^2)	square meters (m^2)
million gallons per day (mgd)	million liters per day (ML/d)	acre (ac)	hectare (ha)
for larger flows (over 264 mgd)	cubic meters per day (m^3/d)	square miles (mi^2)	square kilometers (km^2)
gallons per minute (gpm)	liters per minute (L/min)	**Weight**	
Power		pounds (lb)	kilograms (kg)
horsepower (hp)	kilowatts (kW)	pounds per day (lb/d)	kilograms per day (kg/d)
British Thermal Units (BTUs)	kilojoules (kJ) / watt-hours (Wh)	ton – aka short ton (tn)	metric ton or tonne (MT)
Velocity		**Pressure**	
feet per second (fps)	meters per second (m/s)	pounds/square inch (psi)	kiloPascals (kPa)
miles per hour (mph)	kilometers per hour (km/h)	Inches water column (in wc)	kiloPascals (kPa)
Gas		**Head**	
cubic feet per minute (ft^3/min)	cubic meters per minute (m^3/min)	feet of head (ft of head)	meters of head (m of head)

Thank you

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Build relationships with water industry leaders *and* make a positive impact on the water environment

Join NEWEA's 2021 Annual Sponsor Program

NEWEA offers companies the opportunity to promote their products and services throughout the year by participating in multiple sponsorship activities. Annual Sponsorships include:

- NEWEA Annual Conference
- NEWEA Spring Meeting & Golf Tournament
- NEWEA Golf Classic
- A web presence on NEWEA.org's sponsorship program page
- The option to customize sponsorship levels by selecting to participate in up to eight additional unique NEWEA events plus additional activities

Sponsorship Benefits:

- Increased corporate visibility and marketing opportunities before a wide audience of water industry professionals
- Relationship-building access to key influencers involved in advancing water industry services, technology, and policy
- Recognition as an environmental leader among peers and customers

For more information
contact Jordan Gosselin
Email: jgosselin@newea.org
Phone: 781-939-0908

NEWEA
WORKING FOR WATER QUALITY

Advertiser Index

Upcoming 2021 *Journal* Themes

Spring—**Biosolids/Residuals Management**

Summer—**Innovation**

Fall—**Environmental Justice**

Winter—**Operator Ingenuity**

NEWEA/WEF* Membership Application 2020

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

Personal Information (please print clearly)

Last name | M.I. | First Name | (jr. sr. etc)

Business Name (if applicable)

Street or P.O. Box (☐ Business Address ☐ Home Address)

City, State, Zip, Country

Home Phone Number | Mobile Phone Number | Business Phone number

Email Address

☐ Check here if renewing, please provide current member I.D.

***NEWEA is a member association of WEF (Water Environment Federation). By joining NEWEA, you also become a member of WEF.**

Employment Information (see back page for codes)

1. ORG Code | Other (please specify) | 2. JOB Code: | Other (please specify)

3. Focus Area Codes | Other (please specify

Signature (required for all new memberships) | *Date*

Sponsorship Information

WEF Sponsor name (optional) | Sponsor I.D. Number | ACQ. Code for WEF use only | WEF 20

Membership Categories (select one only)

		Member Benefit Subscription	Dues
☐ **Professional Package**	Individuals involved in or interested in water quality	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online*	$185
☐ **Young Professional Package**	New members or formerly student members with 5 or less years of experience in the industry and less than 35 years of age. This package is available for 3 years. Date of birth (mm/yy) _____	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online*	$70
☐ **Professional Wastewater Operations (PWO) Package**	Individuals in the day-to-day operation of wastewater collection, treatment or laboratory facility, or for facilities with a daily flow of < 1 mgd or 40 L/sec. License # _____	■ WE&T (including *Operations Forum*) ■ *WEF Highlights Online*	$110
☐ **Academic Package**	Instructors/Professors interested in subjects related to water quality.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *Water Environment Research* (Online)	$185
☐ **Student Package**	Students enrolled for a minimum of six credit hours in an accredited college or university. Must provide written documentation on school letterhead verifying status, signed by an advisor or faculty member.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *Water Environment Research* (Online)	$15
☐ **Executive Package**	Upper level managers interested in an expanded suite of WEF products/services.	■ *WE&T* (including *Operations Forum*) ■ *WEF Highlights Online* ■ *World Water* ■ *Water Environment Research* (Online) ■ *Water Environment Regulation Watch*	$355
☐ **Dual**	If you are already a member of WEF and wish to join NEWEA		$45
☐ **Corporate Membership** (member benefits for one person)	Companies engaged in the design, construction, operation or management of water quality systems. Designate one membership contact.	■ *WE&T* (including *Operations Forum*) ■ *Water Environment Research* (Print) ■ *Water Environment Regulation Watch* ■ *WEF Highlights Online*	$420
☐ **New England Regulatory Membership**	This membership category is a NEWEA only membership reserved for New England Environmental Regulatory Agencies, including: USEPA Region 1, CT Department of Energy and Environmental Protection, ME Department of Environmental Protection, MA Department of Environmental Protection, NH Department of Environmental Services, VT Department of Environmental Conservation, and RI Department of Environmental Management		$50

WEF Utility Partnership Program (UPP): NEWEA participates in the WEF Utility Partnership Program (UPP) that supports utilities to join WEF and NEWEA while creating a comprehensive membership package for designated employees. As a UPP Utilities can consolidate all members within their organization onto one account and have the flexibility to tailor the appropriate value packages based on the designated employees' needs. Contact WEF for questions & enrollment (703-684-2400 x7750).

Payment

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Depending upon your membership level, $10 of your dues is allocated towards a subscription to the NEWEA Journal.

NEWEA/WEF* Membership Application 2020

Water Environment Federation® the water quality people®

NEWEA WORKING FOR WATER QUALITY

To help us serve you better, please complete the following:
(choose the one that most closely describes your organization and job function)

What is the nature of your ORGANIZATION?

(circle one only–required) (ORG)

1
Public/Private Wastewater Plants and/or Drinking Water and/or Stormwater

2
Public/Private Wastewater Only

3
Public/Private Drinking Water Only (e.g. municipality, utility, authority)

4
Industrial Systems/Plants

5
Consulting or Contracting Firm

6
State, Federal, Regional Government Agency

7
Research or Analytical Laboratories

8
Educational Institution

9
Manufacturer of Water/Wastewater/ Stormwater Equipment or Products

10
Water/Wastewater/Stormwater Product Distributor or Manufacturer's Rep.

11
Public/Private Stormwater (MS4) Program Only

12
Public Financing, Investment and Banking

13
Non-profits

99
Other _____
(please specify)

What is your Primary JOB FUNCTION?

(circle one only) (JOB)

1
Management: Upper or Senior

2
Management: Engineering, Laboratory, Operations, inspection, Maintenance

3
Engineering and Design Staff

4
Scientific and Research Staff

5
Operations/Inspection Maintenance

6
Purchasing/Marketing/Sales

7
Educator

8
Student

9
Elected or Appointed Public Official

10
Other _____
(please specify)

What are your KEY FOCUS AREAS?

(circle all that apply) (FOC)

1
Collection Systems

2
Drinking Water

3
Industrial Water/Wastewater/ Process Water

4
Groundwater

5
Odor/Air Emissions

6
Land and Soil Systems

7
Legislation (Policy, Legislation, Regulation)

8
Public Education/Information

9
Residuals/Sludge/Biosolids/Solid Waste

10
Stormwater Management/ Floodplain Management/Wet Weather

11
Toxic and Hazardous Material

12
Utility Management and Environmental

13
Wastewater

14
Water Reuse and/or Recycle

15
Watershed/Surface Water Systems

16
Water/Wastewater Analysis and Health/ Safety Water Systems

17
Other _____
(please specify)

Optional Items (OPT)

Years of industry employment? _____
1 (1 to 5) **2** (6 to 10) **3** (11 to 20)
4 (21 to 30) **5** (>30 years)

Gender? _____
1 Female **2** Male

Education level? (ED) _____
1 High School **2** Technical School
3 Some College **4** Associates Degree
5 Bachelors Degree
6 Masters Degree **7** JD **8** PhD

Education/Concentration Area(s) (CON) _____
1 Physical Sciences (Chemistry, Physics, etc.)
2 Biological Sciences **3** Engineering Sciences
4 Liberal Arts **5** Law **6** Business

Water quality professionals, with fewer than 5 years working experience and under the age of 35, are eligible to join WEF as an Active Member, while participating in the NEWEA/WEF Young Professionals Program. This program allows up to 50% off of the Active Member dues, valid for the first three years of membership. This program is available for new member applicants and Student Members.

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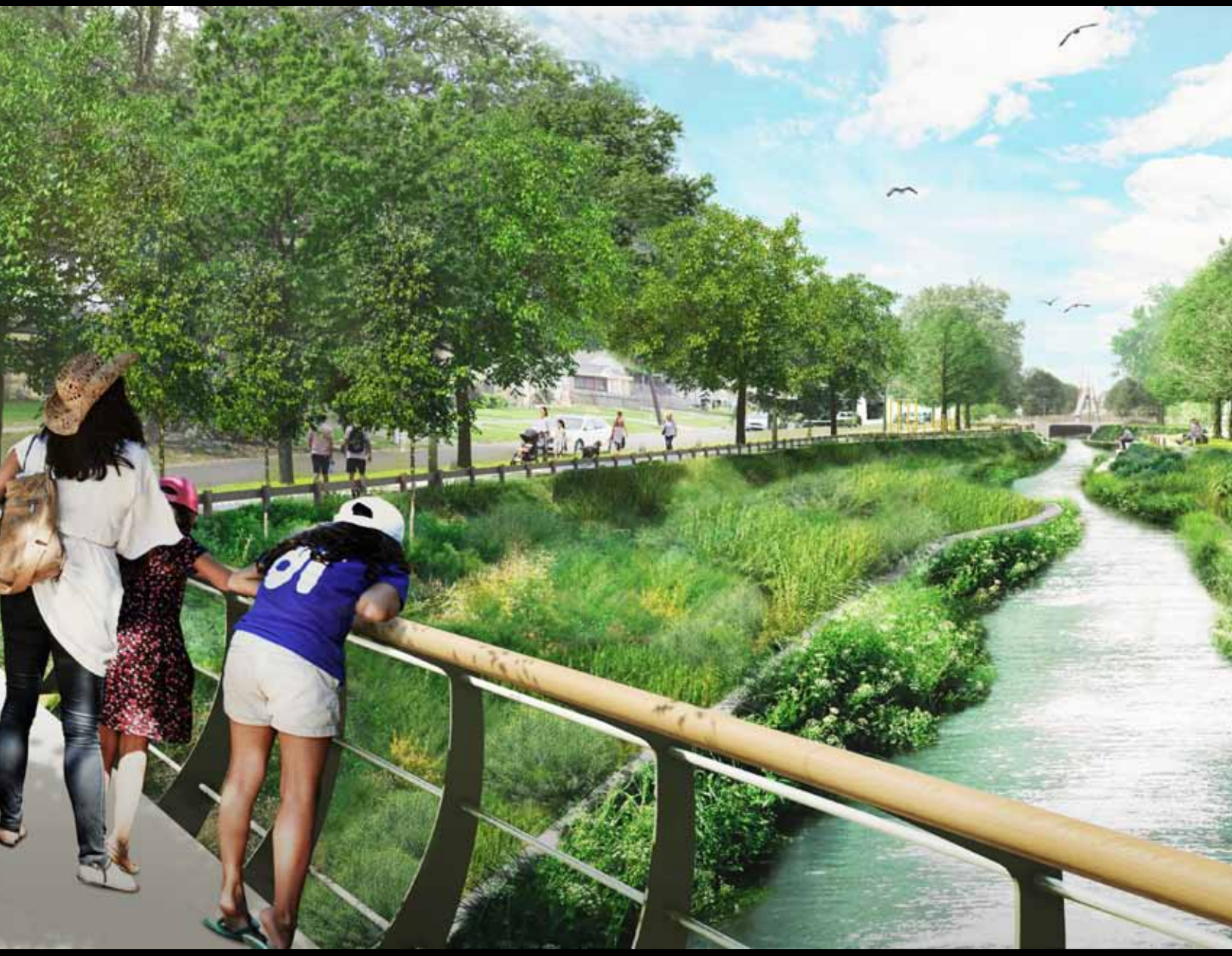

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